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A COMPARISON OF CERTAIN METHODS OF MEASURING RANGES OF SMALL MAMMALS

BY LUCILLE F. STICKEL

Home range, as applied to mammals, has been defined by Burt (1943) as that area traversed by the individual in its normal activities of food gathering, mating, and caring for young. Occasional sallies outside the area were specifically excluded.

Results of small mammal trapping studies have generally been in accord with this concept. Mapped ranges of individuals usually fall within a limited area, but occasional records are at extreme distances. These longer trips are more numerous in the records of young animals, where they may represent wandering and dispersal of animals without established ranges. Some adults, however, make long movements or trips, with subsequent return to the home range (Blair, 1943; Storer, Evans, and Palmer, 1944). These trips, although usually infrequent in a single trapping period, may be important in orientation; they at least partially explain the apparent familiarity with large areas that is shown in homing studies. They may represent a natural tendency for exploration that is important in invasion of depopulated areas and in extension of species ranges.

Within the home range, some parts of the area may be subject to more intensive use than others, as discussed by Hayne (1949). Use patterns may change as conditions change, and the "boundaries" may vary and shift from time to time. In fact, the boundaries of the range must be considered diffuse and general rather than sharply or definitely outlined. These factors work against an accurate measurement of range size, and too great precision cannot be expected. To these difficulties must be added the interference of trapping.

One may wonder whether it is worth while to attempt to measure anything as indefinite and variable as a home range. On the other hand, it is well established that ranges vary widely in size, even for a single species. Food supply, cover, population density, territoriality and other factors may be reflected in size of range. Home range can be considered to represent the living area of the animal; its size is related to the living requirements. Often it is essential for population estimation and other ecological purposes to know the approximate size of range. For these reasons a variety of attempts have been made to express the variation through measurements.

In the first part of the present paper, artificial populations are used to compare different methods of home range measurement. In the second part, field data are discussed.

COMPARISONS IN ARTIFICIAL POPULATIONS

In this section artificial populations are set up under idealized conditions so that fundamental differences in methods of measurement will appear, without complication by such problems as number of captures, trips outside the range, possible interference by traps, and other very real problems encountered in working with actual populations. The comparisons are of methods that have been used to express home range size from data obtained by grid trapping. In this common form of area trapping, traps are set at regular intervals over a plot of land, animals are marked and released, and trapping is continued until individuals have been recaptured a number of times. The method is varied a little for animals using runways, by allowing some leeway from the grid point so that the trap can be set in a runway.

For the first trials a "grid of traps" was constructed on graph paper, with "traps" at 50- and 100-foot intervals on a scale of 1 cm. = 50 feet. The sheet of graph paper, measuring 40 cm. each way, contained 1681 "traps" at the 50-foot spacing and 441 "traps" at the 100-foot spacing. A "home range" of circular shape, 200 feet (4 cm.) in diameter, with an area equivalent to 31,429 square feet, was cut from a sheet of transparent plastic. Another was made in oblong shape with semicircular ends. It had dimensions of 335 x 100 feet (6.7 x 2 cm.), and had an area equivalent to 31,357 square feet.

Random tosses of the disk and oblong were made to determine the number and arrangement of traps that would fall within a given range. One hundred trials were made with the 200-foot circular range and results were recorded for 50- and 100-foot spacing. Fifty trials were made with the oblong range and results were recorded for both trap spacings.

The data were then organized according to different methods of home range expression. The results compare the different methods under the theoretical conditions that (1) all animals are taken in all traps that lie within their ranges and in no others, (2) that all individuals in a given test have ranges of the same size and shape, and (3) that the ranges have finite boundaries.

The methods compared are, briefly:

(1) Minimum area method. Sites of capture are connected by straight lines, and the enclosed area is measured. This is the method used by Dalke (1942) and also recommended by Mohr (1947).

(2) Boundary strip method. A boundary strip equal in width to half the distance between traps is laid off around the minimum area, and the area enclosed is measured. This method is based on the logical assumption that animals range, *on the average*, half way to the next trap beyond their peripheral capture sites.

(a) Inclusive boundary strip method. For ease in calculation, the external points of capture are considered centers of rectangles, the sides of which equal the distances between traps. Exterior corners of these rectangles are connected, and so enclose a considerable area (Fig. 1A, and Blair, 1940*a*). (b) Exclusive boundary strip method. Rectangles are constructed as described in 2a but the corners are so connected as to enclose less area (Fig. 1B).

(3) Observed range length. The distance between the most widely separated capture sites is measured. This is the linear expression of range commonly used by naturalists. It has been applied to area trapping data by a number of workers.

(4) Adjusted range length. One half the distance to the next trap is added to each end of the line drawn to measure the observed range length. This is the logical development from the observed range length on the same basis that the boundary strip method is used in place of the minimum area method.

Results are shown in Tables 1 and 2. The first part of each table shows average values for

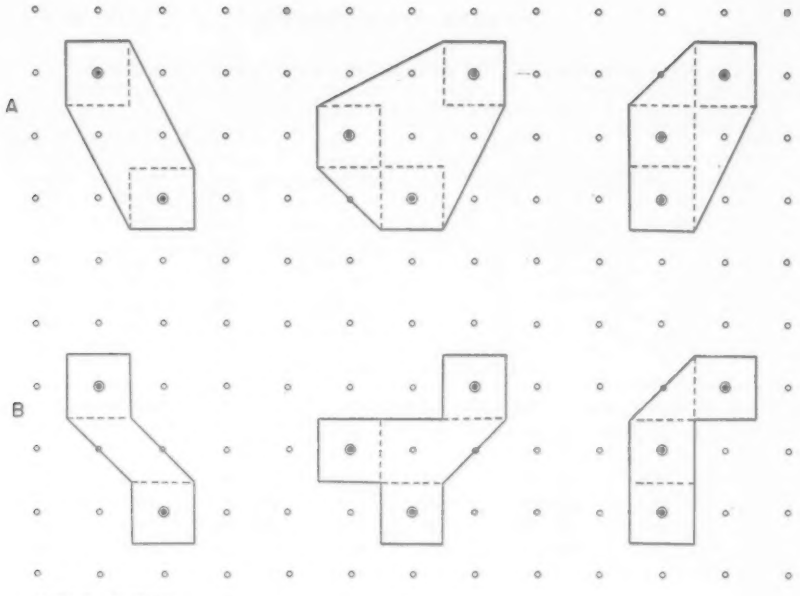

FIG. 1.—Two variations in method of outlining ranges for size measurement. (A) Inclusive boundary strip method. (B) Exclusive boundary strip method.

TABLE 1.—*Comparison of methods of calculating area of home range*

PART 1. SUMMARY OF DATA FROM ARTIFICIAL POPULATION

Series	Number of Trials	Trap Spacing (feet)	Range Shape	Actual Range Area (square feet)	Calculated Area of Range—Averages		
					Minimum Area (sq. ft.)	Boundary Strip—B. Exclusive Method (sq. ft.)	Boundary Strip—A. Inclusive Method (sq. ft.)
A	100	50	Circular	31,429	17,963	31,875	35,450
B	50	50	Oblong	31,357	13,025	31,050	38,750
C	100	100	Circular	31,429	7,901	31,500	33,850
D	50	100	Oblong	31,357	6,964	33,300	39,300

PART 2. STATISTICS FOR DATA OF PART 1

Series	Actual Range Area	Minimum Area Method			Exclusive Boundary Strip Method			Inclusive Boundary Strip Method		
		Range	σ	σ_M	Range	σ	σ_M	Range	σ	σ_M
A	31,429	15,000–20,000	1892	189	27,500–35,000	2484	248	30,000–42,500	2300	230
B	31,357	10,000–15,000	1092	154	25,000–35,000	2185	309	32,500–43,750	3326	470
C	31,429	5,000–10,000	2468	274	20,000–40,000	7125	713	20,000–40,000	7066	707
D	31,357	5,000–15,000	2783	526	20,000–50,000	7043	996	20,000–65,000	11446	1619

TABLE 2.—*Comparison of methods of expressing home range length*

PART 1. SUMMARY OF DATA FROM ARTIFICIAL POPULATION

Series	Number of Trials	Trap Spacing (feet)	Range Shape	Calculated Range Length—Averages		
				Actual Range Length (feet)	Observed Range Length (feet)	Adjusted Range Length (feet)
A	100	50	Circular	200	177	227
B	50	50	Oblong	335	283	333
C	100	100	Circular	200	132	232
D	50	100	Oblong	335	207	307

PART 2. STATISTICS FOR DATA OF PART 1

Series	Actual Range Length	Observed Range Length			Adjusted Range Length		
		Range	σ	σ_M	Range	σ	σ_M
A	200	160–200	7.9	.8	210–250	7.9	.8
B	335	225–320	17.1	2.4	275–370	17.1	2.4
C	200	100–140	15.6	1.6	200–240	15.6	1.6
D	335	100–315	57.9	8.2	200–415	57.9	8.2

all trials as calculated by different methods. Part 2 gives the range of variation, standard deviation, and standard error of the mean for ranges calculated by the different methods.

It is apparent that the boundary strip method of calculating range area gives results closest to the true range. Calculation by the exclusive boundary strip method (2b, above, and Fig. 1B) is most accurate. The range size calculated by the minimum area method is much smaller than the true range, the error averaging 64 per cent in these trials. The range size calculated by the exclusive boundary strip method averaged 2 per cent too large. By the inclusive boundary strip method the calculated ranges averaged 17 per cent too large. In the range length comparisons the observed range length averaged 25 per cent smaller, and the adjusted range length averaged 3 per cent larger than the true range length.

In the examples discussed above, traps were close enough together for at least two traps to be located in the range of *each* individual. If traps were too far apart, average range calculations by any of the above methods would be of little value and generally misleading. This is discussed later in this paper.

SIMULATED TRAPPING IN ARTIFICIAL POPULATIONS

When field data are tabulated to show length or area of range, the known range tends to increase at successive captures, rapidly at first and then more slowly. In certain studies, trapping has been continued until the home range reached an apparent maximum, and additional captures did not increase the known range size. This result was reported by Haugen (1942) for rabbits and by Blair (1942) for deer mice.

In this section, the relation between number of captures and known size of range is considered through examples of simulated trapping in the artificial populations described in the previous section. The number and pattern of traps within each range were determined by the random tosses of disk and oblong on a graph paper grid, as explained earlier. For the "trapping", the general procedure was to number the "traps" in the range of each individual in sequence, and then draw numbers at random to show what trap the individual would be captured in on a given day. Fisher's random number tables (Fisher and Yates, 1948) were used for this purpose. Then the records were handled like actual trap data—ranges were mapped and measurements were made.

(1) For the first example, three populations of 25 individuals each were used. Individual ranges were circular with 200-foot diameter, and traps were on a 50-foot grid. In the first population individuals were assumed to visit available traps at random; that is, there was equal probability of capture in each trap in the range. The members of the other two populations were assumed to favor the traps nearer the center of their ranges, with a declining intensity of use toward the periphery. The varying intensity of trap use was produced by assigning more numbers, and hence more chances, to some traps than others. The range of each individual was divided into three concentric zones of equal width. The inner zone was a circular area with a 33⅓-foot radius, the second was a 33⅓-foot wide belt around the inner zone, and the outer zone extended an additional 33⅓ feet beyond the limits of the second. In one population, traps in the inner zone were each assigned four chances of capture, traps in the second zone two chances, and traps in the outer zone one chance. In the other population the inner zone traps were more strongly favored, being assigned nine chances to three in the middle zone and one in the outer zone.

Relationship between range length and number of captures is shown in Figure 2A as averages for the 25 individuals of each population. In all three populations the known range size increased with successive captures, more rapidly at the earlier captures and more slowly later.

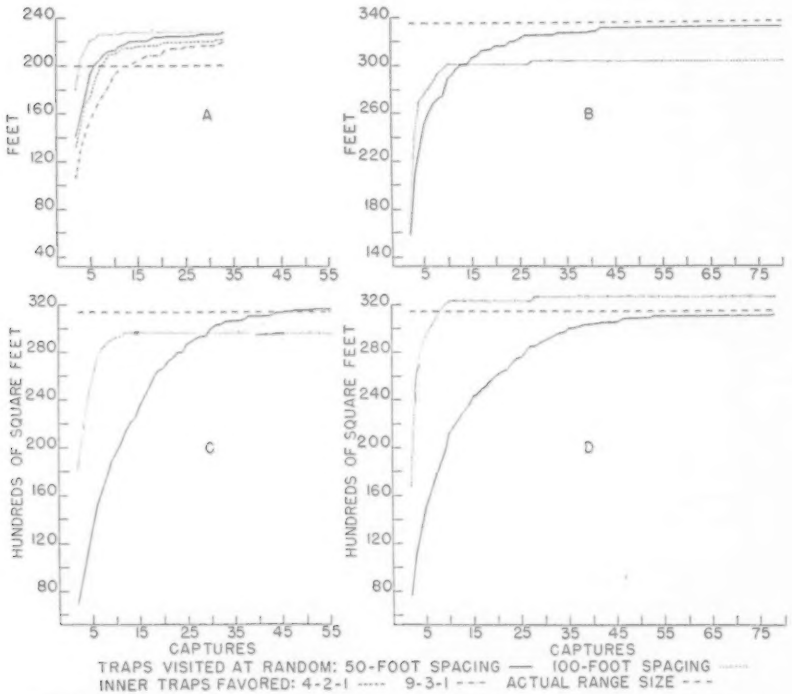

FIG. 2—Mean range at successive captures in artificial populations. (A) Adjusted range lengths; circular ranges of 200-foot diameter. (B) Adjusted range lengths; oblong ranges of 335-foot length. (C) Range area calculated by exclusive boundary strip method; circular ranges of 31,429 sq. ft. area. (D) Range area calculated by exclusive boundary strip method; oblong range of 31,357 sq. ft. area.

TABLE 3.—*Artificial populations. Captures required for individuals to reach the limits of their ranges*

NUMBER OF CAPTURES	HOME RANGE AREA				HOME RANGE LENGTH			
	Circular Range (200 ft. diam.)		Oblong Range (335 ft. length)		Circular Range (200 ft. diam.)		Oblong Range (335 ft. length)	
	50 ft. grid	100 ft. grid	50 ft. grid	100 ft. grid	50 ft. grid	100 ft. grid	50 ft. grid	100 ft. grid
2		6		2	1	9	1	3
3		1		5	1	5		8
4		5		7	1	4		5
5		3		3	3	3	1	2
6		4		2	1	1		2
7		2		2	3	2		1
8		1		1	1		1	2
9		1		2			1	1
10		1					3	
11					1			
12		1			3	1	2	
13					2		2	
14			1		1			
15							1	
16			1		1		1	
17					1		2	
18	2				1		2	
19								
20			1				1	
21					1			
22								
23	2						1	
24			1		1			
25	3							
26	1		1				2	
27	1		1					
28			1	1	1			1
29			1					
30	2		1					
31	2							
32	1		1					
33	2		2		1		1	
34	1		1					
35			2					
36								
37	1		2					
38	2		1					
39								
40			1				1	
41								
42			1					
43	1		1				1	
44	1							
45								
46	1		2					
47								
48	1							
49								
50								
51			1					
52	1							
78			1				1	

When traps were visited at random, the last individual reached its maximum range length at 33 captures, and so the greatest mean value was achieved only then, even though most individuals reached their range limits with many fewer captures. More than half had achieved maximum values at 12 captures (Table 3). As discussed earlier, this range size is itself an estimate whose precision depends on several factors. For these 25 individuals the estimate is 27 feet greater than the true range. The standard error of the mean in Part 2 of Tables 1 and 2 shows the random variation to be expected in average range size estimates of other groups of individuals in this population, where all ranges are actually the same size.

When the inner traps were favored, the curves ascended at a lower level and all individuals had not reached their range limits even after 33 captures, although the mean values were not far apart.

If, in contrast, traps toward the periphery of the range were favored, fewer captures would be needed to show maximum range size than when traps were visited at random.

All curves have roughly the appearance of curves calculated from field data. This pattern in field data, therefore, does not necessarily reveal the pattern of trap visiting, for it occurs even when traps are visited at random.

(2) In the next examples, artificial populations whose members had ranges of similar size but different shape were used. The first population was composed of 25 individuals with circular ranges of 200-foot diameter. The second population was composed of 25 individuals with oblong ranges of 335-foot length. Simulated trapping at 50- and 100-foot intervals was done in each population. The number and pattern of traps within each range were determined as described above. Range sizes were calculated by exclusive boundary strip and adjusted range length methods. Only the random trap visiting pattern was used in these examples. However, general conclusions concerning the effect of range shape and trap spacing should be the same if the experiments were repeated with inner zone traps favored as in the preceding example. Results are shown in Figure 2, A-D. As in the first example, average range size increased at successive captures, rapidly at first and then more slowly, until the curve leveled off.

In these examples (1) the curve levels off more slowly when the traps are closer together (2) the range size is shown with fewer captures when the range is circular than when it is elongate; and (3) it takes fewer captures to show range length than it does to show area. The graphs show averages. Variation among individuals is shown in Table 3. Figures in the body of the table represent the number of individuals whose maximum range size was reached at the stated number of captures. For example, six individuals with circular ranges required only two captures to show maximum range area when traps were 100 feet apart.

Variations in trap spacing, range shape, and pattern of trap visiting probably affect home range estimates made from field data much as they affect estimates based on artificial populations. The problem is more complicated, however, for range sizes, shapes, and manner of trap visiting may vary among the individuals of the population being studied. Field data are often too few to show the leveling of the curve, and when the curve is still ascending it is of doubtful value in estimating range size. Sometimes the curve appears to level off and then rises again. It is often difficult to be sure the range would not increase further with subsequent captures.

But when field data are extensive and do show range increase to a level that is not increased with further captures, it is to be supposed that a reasonably reliable estimate of range size can be made. The possibility of presence of traps or spacing of traps altering behavior of the animals will be discussed in a later section.

DISTANCE FROM CENTER OF ACTIVITY

In addition to other uses for which it was primarily intended, distance from center of activity has been suggested as an index to range size (Hayne, 1949). The center of activity is the geographic center of all points of capture, computed from the trapping data as described by Hayne.

Distances from center of activity were plotted for the individuals of certain of the pre-

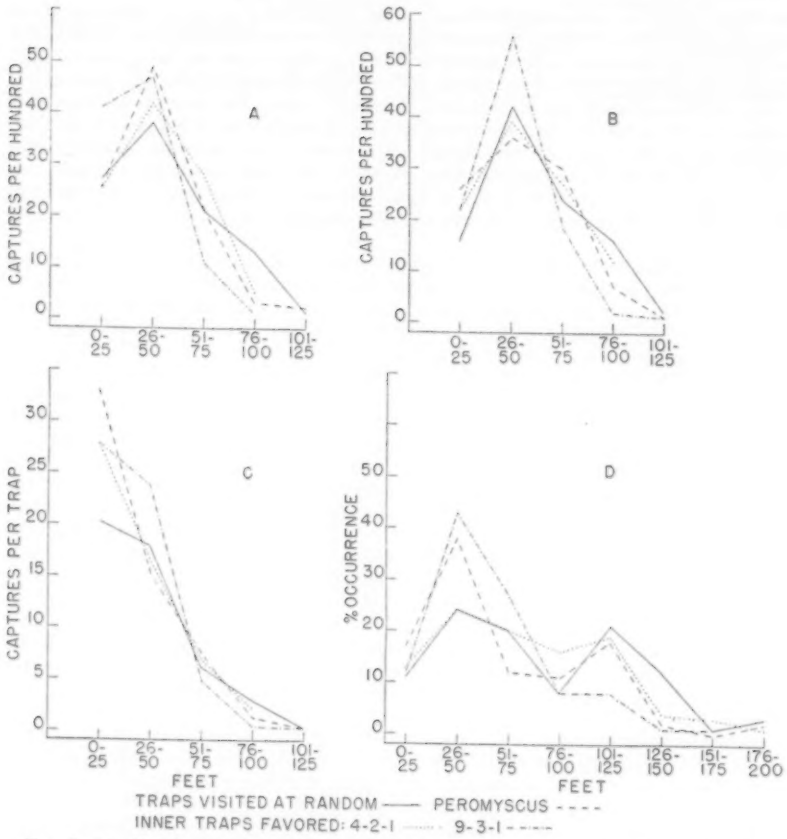

FIG. 3.—Artificial populations, ranges 200 feet in diameter, traps at 50-foot intervals; and a *Peromyscus* population, traps at 50-foot intervals. (A) Distances from center of activity after 3 captures per individual. (B) Distances from center of activity after 4 captures per individual. (C) Captures per trap theoretically available at different distances from center of activity, after 4 captures per individual. (D) Distances between successive captures after 4 captures per individual.

viously-used artificial populations. Field data for 19 adult male *Peromyscus* were similarly treated for comparison. The *Peromyscus* data are from a previously reported study (Stickel, 1948*a*), in which trapping was on a 50-foot grid and the general magnitude of ranges was roughly the same as those used in the study of artificial populations.

Distances from center of activity in the *Peromyscus* sample are shown in Figure 3. They are compared with the distances from the center of activity in artificial populations with circular ranges of 200-foot diameter. The distribution of distances in an artificial population whose members had oblong ranges is shown in Figure 4. The distribution of distances in the artificial populations varies with the pattern of trap visiting, the shorter distances predominating more strongly when the inner zone traps had nine chances of capture to three

for the middle zone and one for the outer zone of traps. In the population where inner zone traps had four chances to two for the middle zone and one for the outer zone, the shorter distances were also a little more frequent than when traps were visited at random. Random variation also has considerable influence on the distribution of distances, as shown by the differences in distributions after three and after four captures per individual.

No conclusion can be drawn from this data concerning the pattern of trap visiting of these *Peromyscus*, and especially so, since shape of the *Peromyscus* ranges is not known. It is apparent, however, that even if traps are visited entirely at random, a descending frequency of visits to traps at greater distances from the center of activity will appear after the initial upswing. This tendency can be expected to decrease when the number of captures is further increased. In field data, however, most individuals ordinarily have few captures, and the number of captures per individual varies. The opposite effect—an increase in scattered records at greater distances—is produced when a few individuals have exceptionally large ranges, or when an occasional trip outside the home range is included. Elongate ranges also result in more of a scattering of records at greater distances than do circular ranges of the same area (Fig. 4A).

In Figures 3C and 4B, data from the artificial populations and the *Peromyscus* population are presented in another form, which was proposed by Hayne (1949). The number of captures at each distance from the center of activity is compared with the number of traps theoretically available at that distance to see if captures are in proportion to traps. If captures per trap were greater at the shorter distances, and fewer at greater distances, it would seem to indicate a greater tendency to visit traps close to the center of activity. In the examples, the curves, although differing from each other, take the same general form when traps are visited at random as when the inner traps are favored, contrary to expectation. The reduced number of captures per trap at the greater distances is influenced in part by the fact that the number of traps theoretically available at the greater distances exceeds the number actually available. The reason for this is that the calculated center of activity usually will not lie exactly on the true center of activity, and will often depart considerably when there

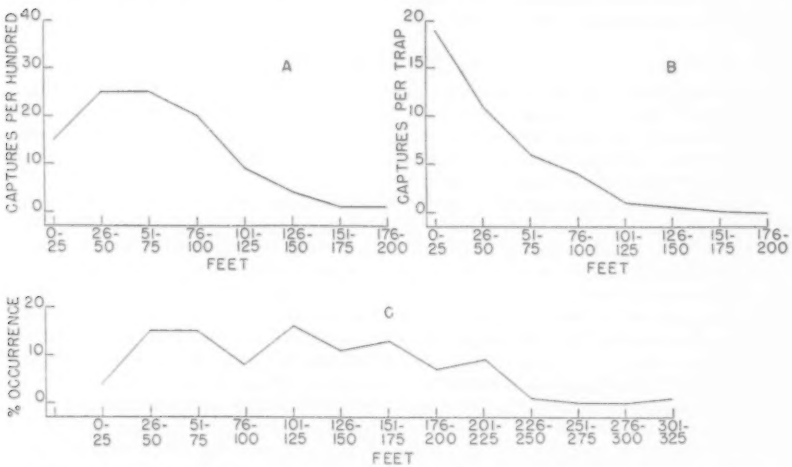

FIG. 4.—Artificial populations with oblong ranges of 335-foot length and traps at 50-foot intervals. Measurements after 4 captures per individual, traps visited at random. (A) Distances from center of activity. (B) Captures per trap theoretically available at different distances from center of activity. (C) Distances between successive captures.

are only a few captures. Then the area for which theoretically available traps is calculated will lie partly outside the range of the individual concerned. The discrepancy would be even greater if the range were not circular.

The distribution of distances from center of activity as shown in Figures 3 and 4 is apparently influenced by range shape, trap spacing, pattern of trap visiting, and number of captures per individual, as well as by the size of the home range. Concrete interpretation in terms of home range size will require further analysis than undertaken here.

DISTANCES BETWEEN CAPTURES

Distances between capture sites have been used by a number of workers as an index to extent of range. Distances are measured between successive captures or, sometimes, from the point of original capture. An advantage of this method is that data can be used from all animals taken as often as twice; this is an important advantage if the animals are trap shy or if trapping periods must be brief. Disadvantages of the method in field use are that individuals captured more frequently have more weight in the calculations, unless some adjustment is made. Records of transients or wandering individuals also alter the results.

The artificial populations and the *Peromyscus* sample used in the previous section were studied to find distances between successive captures. The distribution of these distances is shown in Figures 3D and 4C. Although the distributions are very irregular, there appear to be differences related to range shape and to pattern of trap visiting. More short distances are recorded when inner traps are most strongly favored. However, even when traps are visited at random, more short distances appear than longer ones. Chitty (1937) pointed out that in random trap visiting there are fewer chances for recording greater distances than lesser ones.

The spacing of the traps helps bring about the irregularities in the distributions, for only certain distances will be possible. The combinations of traps to produce different distances will be fewer when traps are widely spaced. On the basis of these limited examples, no attempt will be made to relate actual range size to distances between captures.

The use of distances between captures as an index to range size, when traps are not set on a grid, is discussed by Davis (1953).

FIELD COMPARISONS

When range sizes are estimated from trapping data, one rarely can be sure how much trapping interferes with normal activities of the animals. It is seldom possible to know how far they would be traveling or what they would be doing if they were not in traps. There is some evidence, however, that ranges revealed by live trapping are significantly related to the natural ranges and not merely artifacts.

Home ranges studied by different methods.—A few workers have been able to support their trap-determined home range data with other observations. Davis, Emlen, and Stokes (1948) found that between 70 and 80 per cent of rats caught and released in Baltimore were retaken within 40 feet of the original point of capture. When colored-bait stations were established and colored scats were collected from the surrounding area, 85 per cent of the recoveries were within 50 feet of the corresponding stations.

Blair (1951) found that the range size estimated by live-trapping beach mice corresponded very closely with range indications derived from following released animals to their burrows, and fairly closely with results of tracking individual animals.

Home range data obtained by grid trapping prairie deermice (Blair, 1940*b*) were compared with data from nest box observations by Howard (1949). Howard reported that a deermouse regularly travels over an area of five or six acres, whereas Blair recorded average ranges of a little over half an acre. These differences are striking, but further examination of data shows that the estimates were arrived at so differently that they are probably not comparable.

Howard measured the distance between the nest box where a mouse was found during the day (the homesite) and the nest box where it was trapped or observed that night. Most of

the nest boxes were 150–300 feet apart, although a few were much closer. The distances recorded were: 2 of 50 ft., 4 of 100 ft., 3 of 150 ft., 2 of 200 ft., 6 of 250 ft., 10 of 300 ft., and 1 of 350 ft. To convert these distances to areas, Howard apparently used the longer records (250 ft. and more) as the radii of circles (a circle of 250-foot radius has an area of 4.5 acres; a circle of 300-foot radius has an area of 6.5 acres). His calculations assume that the homesite is in the center of a circular range, so that a trip of 350 feet from the homesite in one direction would mean that trips of equal distance were made in all directions.

Blair plotted the trap sites of each individual, outlined the ranges by the boundary strip method and measured the area within. Most of Blair's data are not given in the form of linear distances but some distances can be measured from maps of September ranges given in his Figures 1 and 2. Greatest distances across ranges for individual mice were: ♂♂ 80, 80, 95, 180, 240, 360, 380 ft.; ♀♀ 60, 125, 135, 140, 200, 255, and 300 ft.

Thus the actual recorded maximum travels for individual mice are very similar in both studies. However, the distances taken from Blair's maps were maximum measurements for each individual, and could not possibly be considered radii. On the other hand, Howard's records also represent a selection for the greater distances to some extent, for his nest boxes mostly were too far apart to give a fair sample of the travels of mice with smaller ranges.

Although data from the two studies are not strictly comparable it seems possible that the two studies support rather than contradict each other.

Home ranges and trap spacing.—It has been suggested that ranges estimated by grid-trapping may be influenced by trap spacing, closer spacing yielding smaller range estimates (Hayne, 1950). The following data relate to this problem.

In trapping wood mice, feral house mice, and other species, I have almost always found that a few transients or other wandering individuals travel freely across the trapped plot. There is no indication that the traps seriously block their travels. These greater travel records are particularly common among subadults; they may travel back and forth across the full length of a study area, whereas adults, established in their home ranges, cover only a small portion of the same area. Other workers have reported the same behavior for different species. When wood mice were trapped in different habitats at the same trap spacing, the mice showed small ranges in one area and large ranges in the other, giving no indication of blocking (Stickel, 1948*a*).

Two special studies, of wood mice and feral house mice, also bear on this problem.

(1) Wood mice. In trapping wood mice in the bottomlands of the Patuxent Refuge, using a 50-foot grid, I found the average observed length of range to be in the neighborhood of 100–150 feet, with a few males ranging as far as 220 feet and a few females as far as 205 feet. At the same time, and later, wood mice were trapped in the bottomlands using a 165-foot grid. At this wider spacing only a few mice traveled the 165 feet between traps. There were three 5-day trapping periods with 165-foot spacing in 1945 and two in 1949. Among males captured two or more times, 45 were recaptured only in the same trap where originally taken, 11 traveled 165 feet to an adjoining trap, and three traveled 235 feet to the next trap in a diagonal direction across the grid. Among females, 39 showed no travel distance, two traveled 165 feet, and one traveled 235 feet. It was apparent that few mice were traveling as far as 165 feet. The number of captures indicated that only a portion of the population was being captured at all. These travels, or lack of them, show average range sizes quite in accord with those found in trapping at 50-foot spacing.

These results can be made to appear quite different by calculating the adjusted range length and ignoring records of mice captured in only one trap. Average adjusted range lengths of female mice would be estimated as 150 feet from the trapping with 50-foot spacing, but as 298 feet at the 165-foot spacing. Males would show an average range of 200 feet at the 50-foot spacing, but 345 feet at the 165-foot spacing. These discrepancies would be even more conspicuous if the ranges were calculated by the boundary strip method. The principal fallacy lies in calculating an "average" value from a biased sample—biased in favor of showing travels for wide ranging individuals only.

If data are sufficiently reduced by the omission of records of mice with smaller ranges,

even the minimum area method (and observed range length method) erroneously may appear to yield larger ranges at the wider spacings.

In most trapping studies designed to measure range sizes, traps are set closely enough that there will be several traps in the range of each animal. If the traps on a grid were set so far apart that there were no travels between traps, it would be quite apparent that the trapping meant nothing concerning the range of the animals, except that the range was less than the trap spacing. However, if even a small number of animals travels between traps there is a temptation to use data from these animals to calculate range size. The more animals that are dropped out as a result of the wide spacing, the more serious is the error of basing average home range calculations on the data from the few remaining. It is not even a sound procedure to use the boundary strip method to calculate the ranges of these few individually, admitting their ranges are greater than average. For when only a few are caught in more than one trap, it is likely that they are being caught near the limits of their ranges. Then the minimum range or area probably would be closer to the truth, for the theory of adding the border strip or distance would not apply.

Other field studies of wood mice, showing essentially the same ranges at different trap spacings, are reported elsewhere (Stickel, 1948*b*).

(2) Feral house mice. A field of ripening wheat was trapped May 18–24, 1950 on a 60-foot grid, and May 26–June 1, 1950 on a 120-foot grid. During the first period, when traps were set 60-feet apart, 26 adult male mice were captured; each was taken in at least two different traps. During the second period, when traps were set 120 feet apart, 21 mice were captured but only six traveled between traps. Travel data were therefore available for only a small part of the population when traps were set at the wider spacing. Maps of the capture sites did not show any real discrepancy in range sizes at the two spacings. However, if the 15 mice that were caught in only one trap when traps were 120 feet apart are ignored and average ranges are calculated, the results seem quite different. These calculations gave range estimates by the boundary strip method that averaged 17,200 square feet for 19 mice taken five times at the 60-foot spacing, and 33,100 square feet for five mice taken five times each at the 120-foot spacing. Similar calculations of ranges of adult female mice gave very similar results. It is apparent that calculations of the *average* range by the boundary strip method produced an exaggerated range estimate, but the fault is not in the method. Rather the fault lies in applying the method to data from the few wide-ranging individuals that were taken in more than one trap at the unsuitably wide spacing.

The relationship between trap spacing and range size in *Microtus* was studied by Hayne (1950). At the widest spacing employed (120 feet) it seems likely, as also noted by Hayne, that a number of individuals failed to travel between traps because of the smallness of their ranges. Others, of course, may have failed to show their ranges because of the small number of captures possible when so few traps were available. It is possible, therefore, that the large range sizes found when traps were 120 feet apart were influenced by omission of records of mice with smaller ranges combined with use of the boundary strip method of range size calculation, as discussed above.

Another problem is whether different trap spacings will influence estimates of range size when traps are close enough together that there are several in the range of each animal. Hayne (1950) trapped meadow mice at various spacings between 21 and 63 feet. His results for adult female meadow mice are shown in his Figure 2. Although the values for a 60-foot spacing seem to level off very close to values for 30-foot and 45-foot spacings, the values at the 21-foot spacing are consistently low, and the greatest values are achieved by a 60- and 63-foot spacing.

As an attempt to find the mechanical effect of the trap spacing without influence of biological factors, an artificial population of roughly comparable magnitude was set up. Ranges were assumed to be circular, with 60-foot radius (0.26 acre) and ten individuals were trapped eight times each at 20-foot, 30-foot, 40-foot, and 60-foot spacings. Traps were assumed to be visited at random. Average range areas at successive captures are plotted in Figure 5. The smallest values are found at the 20-foot spacing and the largest ones at the

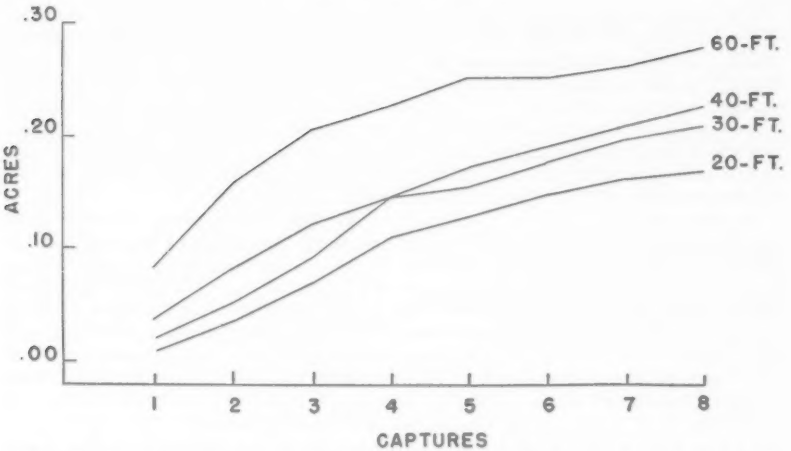

FIG. 5.—Mean apparent home range in an artificial population as shown at successive captures and at different trap spacings. Circular ranges of 0.26 acre area with traps at 60-foot intervals. Traps visited at random. Range sizes calculated by inclusive boundary strip method.

60-foot spacing. The curves generally run at different levels depending on the trap spacing. After several captures, the curves flatten considerably, although they have not completely leveled off. Variation in apparent range size with variation in trap spacing therefore may be due in considerable part to mechanical factors. In the artificial population the curves would level off with further captures, permitting estimates of the range size. In practice it would be extremely difficult to be sure that maximum range values had been shown by individuals and would not increase with further trapping.

In review of the preceding discussion of trap spacing in relation to range size, it is apparent that the proper spacing of traps is an important factor in a field study. The traps should be set close enough together that all resident individuals can be caught in at least two traps; then, of course, most will be caught in more than two traps. On the other hand, the traps should be set as far apart as possible—and still fulfill the preceding requirement—so that it will not take too many captures for the animals to show the extent of their ranges. Wide spacing also makes it feasible to study a larger area and more individuals. Although the literature will provide a guide to suitable trap spacing for many species, a preliminary trial trapping may be necessary. Indeed, if the same species is trapped in different habitats or at different times in a changing habitat, trap spacing that is satisfactory at one time may be too great at another.

Travels outside the home range.—Trapping data intended for home range estimates often show a few records at extreme distances which can be interpreted only as travels outside the home range. These may be the records of transient individuals, of dispersing young, or they may be trips made by resident adults.

In any case, these records must be separated from the others if the home range data are to have significance, particularly for ecological comparisons. There seems to be no completely objective method of distinguishing the trips from normal home range travels, but a study of the mapped ranges of individuals usually will leave little doubt as to which records should be eliminated from home range calculations. If one hesitates to remove such records for fear of introducing personal bias, he should realize that even more serious bias is introduced by leaving them in.

Home ranges and variations in the trapping plan.—In most area-trapping, all traps on the grid are operated at the same time. Sometimes, however, traps are set in different parts of the plot at different times, or alternate rows of traps are operated on successive nights (Blair, 1951 and others). I do not know of field appraisals of these methods. In some *Peromyscus* trapping in 1948 this procedure was followed. A grid with 40-foot spacing was set up and alternate rows of traps were opened, so that spacing on any one night was on a 40x80-foot grid. The resulting range estimates were essentially the same as those made by standard 50-foot grid trapping in the same area in 1946. More rigorous comparisons should be made before concluding that the two procedures give the same results.

In some studies, multiple catch instead of single catch traps are used, or more than one trap is set at a site. A very limited comparison of one vs. two traps per site was made in the summer of 1949. Feral house mice were being studied in a hay field by 60-foot grid trapping, using single catch traps. During trapping in late August, so many *Microtus* were captured that it was feared there might be too few traps available to house mice. Therefore, following the regular seven-day period, trapping was continued for four additional days with an extra trap at each site. Results of four days' trapping Aug. 25–28, and 4 days' trapping Aug. 28–31 (one trap per site) were each compared with trapping Sept. 1–4 (two traps per site). Travels of house mice were not significantly different under the two conditions. Recorded distances were essentially the same for eight individuals, greater with two traps for four individuals, and less with two traps for five individuals. There was a slight increase in number of captures per individual when two traps were present at each site, but even this difference was so small that it probably was not significant. Traps were close together and apparently there were enough traps under either circumstance. Results of other trials are needed for definite conclusions concerning the use of multiple and single catch traps.

Acknowledgments.—I wish to express my thanks to Mr. Arnold L. Nelson for making available facilities and equipment for conducting this study and to Don W. Hayne and William H. Stickel for reviewing the manuscript and making many helpful suggestions.

SUMMARY

A comparison is made of different methods of determining size of home range from grid trapping data. Studies of artificial populations show that a boundary strip method of measuring area and an adjusted range length give sizes closer to the true range than do minimum area or observed range length methods.

In simulated trapping of artificial populations, the known range size increases with successive captures until a level is reached that approximates the true range. The same general pattern is followed whether traps are visited at random or traps nearer the center of the range are favored; but when central traps are favored the curve levels more slowly. Range size is revealed with fewer captures when traps are far apart than when they are close together. The curve levels more slowly for oblong ranges than for circular ranges of the same area. Fewer captures are required to determine range length than to determine range area.

Other examples of simulated trapping in artificial populations are used to provide measurements of distances from the center of activity and distances between successive captures. These are compared with similar measurements taken from *Peromyscus* trapping data.

The similarity of range sizes found in certain field comparisons of area trapping, colored scat collections, and trailing is cited. A comparison of home range data obtained by area trapping and nest box studies is discussed.

It is shown that when traps are set too far apart to include two or more in the range of each animal, calculation of average range size gives biased results. The

smaller ranges are not expressed and cannot be included in the averages. The result is that range estimates are smaller at closer spacings and greater at wider spacings, purely as a result of these erroneous calculations and not reflecting any varying behavior of the animals.

The problem of variation in apparent home range with variation in trap spacing is considered further by trapping in an artificial population. It is found that trap spacing can alter the apparent size of range even when biological factors are excluded and trap visiting is random.

The desirability of excluding travels outside the normal range from home range calculations is discussed.

Effects of varying the trapping plan by setting alternate rows of traps, or setting two traps per site, are discussed briefly.

LITERATURE CITED

BLAIR, W. F. 1940*a*. Home ranges and populations of the meadow vole in southern Michigan. Jour. Wildlife Mgt., 4: 149–161.

———. 1940*b*. A study of prairie deer-mouse populations in southern Michigan. Amer. Midl. Nat., 24: 273–305.

———. 1942. Size of home range and notes on the life history of the woodland deer-mouse and eastern chipmunk in northern Michigan. Jour. Mamm., 23: 27–36.

———. 1943. Populations of the deer-mouse and associated small mammals in the mesquite association of southern New Mexico. Contrib. Lab. Vert. Biol., Univ. Michigan, No. 21: 1–40.

———. 1951. Population structure, social behavior, and environmental relations in a natural population of the beach mouse (*Peromyscus polionotus leucocephalus*). Contrib. Lab. Vert. Biol., Univ. Michigan, No. 48: 1–47.

BURT, W. H. 1943. Territoriality and home range concepts as applied to mammals. Jour. Mamm., 24: 346–352.

CHITTY, D. 1937. A ringing technique for small mammals. Jour. Anim. Ecol., 6: 36–53.

DALKE, P. D. 1942. The cottontail rabbits in Connecticut. State Geol. & Nat. Hist. Surv., Bul. 65: 1–97.

DAVIS, D. E. 1953. Analysis of home range from recapture data. Jour. Mamm., 34: 352–358.

DAVIS, D. E., J. T. EMLEN, JR. AND A. W. STOKES. 1948. Studies on home range in the brown rat. Jour. Mamm., 29: 207–225.

FISHER, R. A. AND F. YATES. 1948. Statistical tables. Hafner Publ. Co., N.Y. 112 p.

HAUGEN, A. O. 1942. Home range of the cottontail rabbit. Ecology, 23: 354–367.

HAYNE, D. W. 1949. Calculation of size of home range. Jour. Mamm., 30: 1–18.

———. 1950. Apparent home range of *Microtus* in relation to distance between traps. Jour. Mamm., 31: 26–39.

HOWARD, W. E. 1949. Dispersal, amount of inbreeding, and longevity in a local population of prairie deermice on the George Reserve, southern Michigan. Contrib. Lab. Vert. Biol., Univ. Mich., No. 43: 1–50.

MOHR, C. O. 1947. Table of equivalent populations of North American small mammals. Amer. Midl. Nat., 37: 223–249.

STICKEL, LUCILLE F. 1948*a*. The trap line as a measure of small mammal populations. Jour. Wildlife Mgt., 12: 153–161.

———. 1948*b*. Effect of bait in live trapping *Peromyscus*. Jour. Wildlife Mgt., 12: 211.

STORER, T. I., F. C. EVANS, AND F. G. PALMER. 1944. Some rodent populations in the Sierra Nevada of California. Ecol. Monog., 14: 165–192.

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LIFE HISTORY OF THE GOLDEN MOUSE, *PEROMYSCUS NUTTALLI*, IN KENTUCKY

By Woodrow W. Goodpaster and Donald F. Hoffmeister

One of the most intriguing of all the North American small mammals is the golden mouse, *Peromyscus* (*Ochrotomys*) *nuttalli*. Its semiarboreal habits, friendly docility, and marked morphological divergence from the "typical" *Peromyscus*-type are of more than passing interest and makes it sought after by biologists. The golden mouse was known to some of our earliest naturalists—Audubon, Bachman, Harlan, and others. Yet, there never has been published any extensive accounts of the life history of *Peromyscus nuttalli*. Therefore, these studies and observations on the golden mouse in northeastern Kentucky seem worthy of record.

Special thanks are extended to Mr. Harry Ahles, of the Herbarium, Department of Botany, University of Illinois, for identification of various seeds from feeding stations; to Mr. Lewis Stannard, Illinois Natural History Survey, for identification of ectoparasites; and to Mr. Charles McLaughlin, Department of Zoology, University of Illinois, for the drawing and map.

This study has been conducted in spare days during parts of the last six years. Approximately 300 nests have been examined, over 100 live animals have been handled, and 67 mice have been skinned and made into specimens.

HABITAT

The high hills and ridges of the Allegheny Plateau, with stands of pines and hardwoods, provide the favorite haunts of golden mice. This habitat has remained nearly untouched for a long time, since this land cannot be successfully devoted to farming. Along the streams, in the valleys between the ridges, there is an abundance of heavy brush in the form of water beech (*Carpinus*), spice bush (*Lindera*), dogwood (*Cornus*), greenbrier (*Smilax*), blackberry (*Rubus*), honeysuckle (*Lonicera*), and wild grape (*Vitis*). Pines and hardwoods are interspersed. These brushy valleys are the favorite haunt of *Peromyscus nuttalli*. At higher elevations, near the top of the ridges, the mice prefer blackberry thickets, pine, and clumps of wild grape and honeysuckle. Honeysuckle is the preferred bush at any elevation. Although greenbrier is an important plant in the habitat of this species, it is not so essential as honeysuckle, or any combination of the kinds of shrubs mentioned above. The height of the trees or of the brush is unimportant as long as the understory is thick and heavy.

A favorite habitat for golden mice, nearly impenetrable to man even in winter, is shown in Plate I. In such a spot as this a person is almost certain to find the nests of *Peromyscus nuttalli* in eastern or central Kentucky. And it is only in these habitats, or in slight variations therefrom, that one does find *P. nuttalli*.

Such habitats occur in Kentucky northward to the Ohio River (Fig. 1). So do the golden mice, for they have been taken in Lewis County, 6 miles east of Vanceburg, on the southern bank of the Ohio (Fig. 1). However, the same type of habitat and topography can be found on the Ohio side of this river yet golden mice have never been taken in Ohio. One plausible reason why *P. nuttalli* does not occur on the Ohio side of the river may be that its northward spread in Kentucky may have been fairly recent. The mice may have reached the Ohio River after it was filled with locks and dams for navigational purposes. These locks and dams tend to keep the water at a fairly high level, even in dry years, and provide an area too wide for mice to swim or be rafted across.

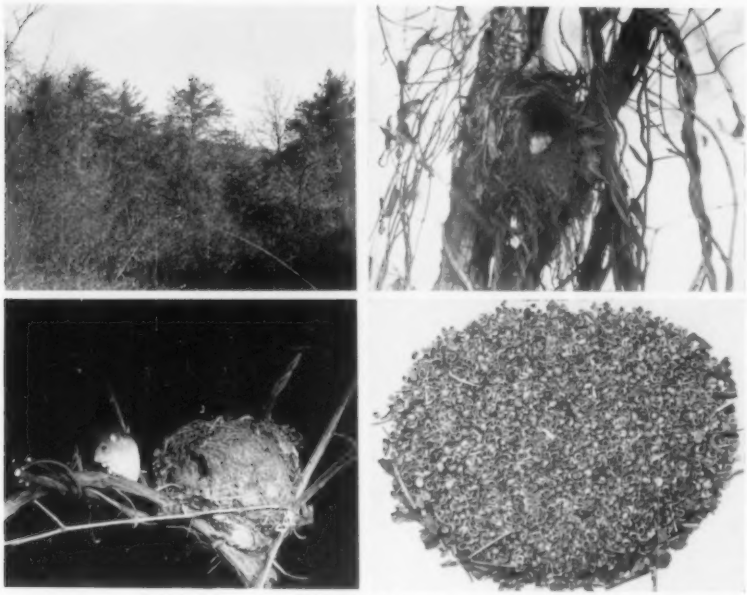

PLATE I

UPPER LEFT: Typical habitat of the golden mouse, *Peromyscus nuttalli nuttalli*, two miles east of Ribolt, Lewis County, Kentucky, February 10, 1952. In such dense thickets of honeysuckle, greenbrier, wild grape, and blackberry, together with some hardwoods and pine, numerous nests and feeding platforms can be found. UPPER RIGHT: Feeding platform of golden mouse, *Peromyscus nuttalli nuttalli*, two miles east of Ribolt, Lewis County, Kentucky. These platforms, when in use, do not have the entrance plugged or closed, and there may be both an open entrance and exit as in this platform. LOWER LEFT: Adult golden mouse, *Peromyscus nuttalli nuttalli*, and nest, situated in a wild grape thicket, Rowan County, Kentucky. The entrance to the nest is normally closed. LOWER RIGHT: Seeds recovered from a single feeding platform.

NESTS

There are two types of nest-like structures used by these golden mice. One is the home where one, two, or an entire family of individuals may live (Table 2). This structure is called the *nest*. It is generally a well-constructed globular mass of leaves, inner-bark, and grass. It may be placed from two to 15 feet up in a tree or tangle of vines. The second nest-like structure is similar in appearance, but not as bulky and may be placed as high up as 50 feet. This serves chiefly as a *feeding platform*, and is a retreat where the mice carry their food, in the form of seeds, to be opened and the contents eaten.

The feeding platforms (Pl. I) are generally more commonly noticed by the investigator than are the inhabited nests. The ratio is about six feeding platforms to each nest. Feeding platforms that are being used do not have the entrances plugged, and in some cases there is an open exit and entrance with only a shallow covering over the top. The bottoms of these platforms are generally a solid mass of shells of seeds discarded after the contents were eaten (Pl. I). In some nests seeds were found that had not been eaten. These were either

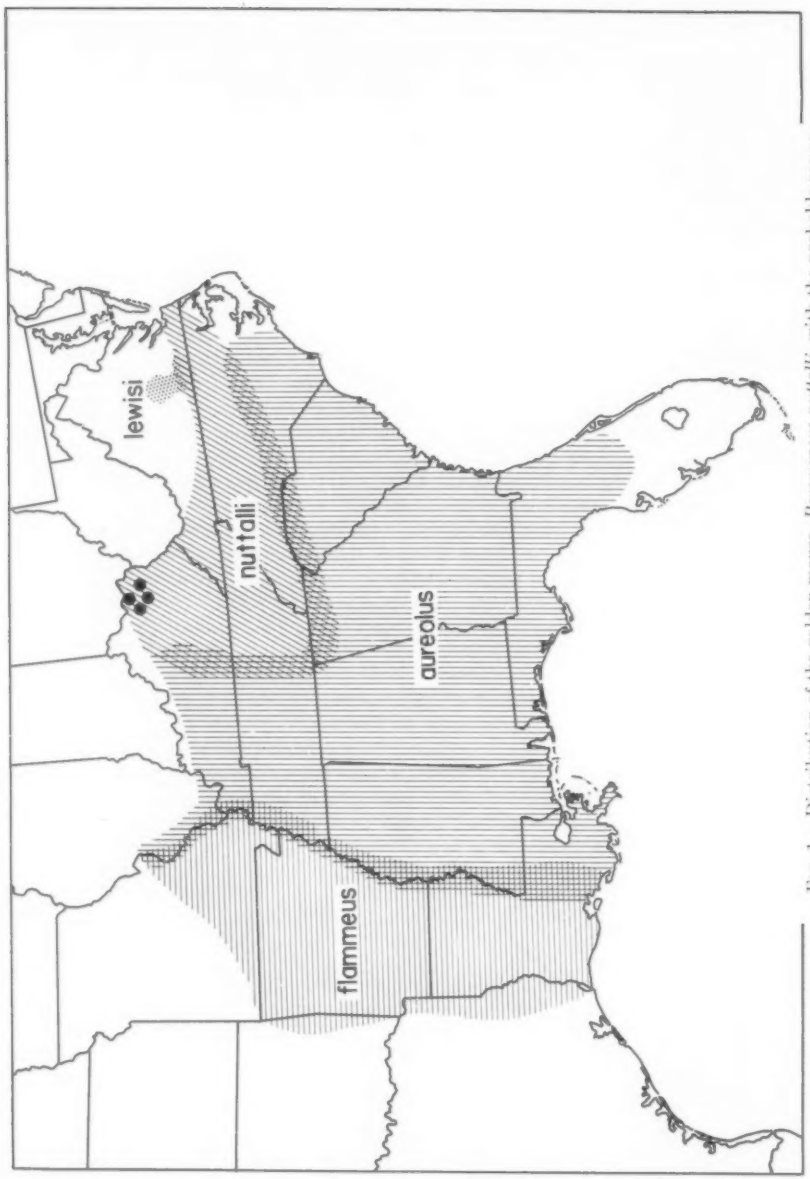

FIG. 1.—Distribution of the golden mouse, *Peromyscus nuttalli*, with the probable range of the various subspecies indicated. The black dots indicate the vicinity of the 12 localities where these studies were made on golden mice in northeastern Kentucky.

not to the taste of the mice or were left there for future consumption. There is reason to believe that sometimes feeding platforms may be converted into nests, and likewise, some nests may be converted into feeding platforms. A list of the seeds found in feeding platforms is given under the account of food.

The nest of the golden mouse (Pl. I) resembles that of *Peromyscus leucopus noveboracensis* except for details of construction.The nest of *Peromyscus leucopus*, if capped with leaves, is generally rough and shaggy. The nest of *Peromyscus nuttalli* has an appearance of a solid mass, rather than of many small parts, and the top is thatched with leaves in such a way that it sheds the rain very readily. If a capping of grass or inner bark is used, it, too, takes on the same appearance, since long strands of these materials are used. A *Peromyscus leucopus* would cut the materials shorter, and as a result the nest would have a looser appearance.

The following kinds of leaves used in the outer construction of the nest were identified: black or wild cherry, black locust, honey locust, birch, honeysuckle, maple, sycamore, oak, beech, dogwood, hackberry, walnut, ash, thorn apple, cucumber tree, wild grape, goldenrod, greenbrier, and blackberry.

The inner parts of the nest are always deeply lined with finely shredded inner bark, "down" from the seedpods of the milkweed, fur (of rabbits), or feathers. It is quite evident that a pair of mice would have to spend many nights in the making of a single nest. There is little doubt that the inside may be added to as new and choicer materials are found. However, the outer covering is apparently never touched after the initial construction, and the nest is expanded from the inside as new material bulges or forces the sides out.

The following kinds of animal and other matter were used in the inner construction of the nest (frequency of occurrence in parenthesis): cardinal feathers (16), chicken feathers (4), bobwhite feathers (3), junco feathers (3), mallard feathers (2), red-eyed towhee feathers (2), starling feathers (1), woodcock feathers (1), bits of newspaper (3), bits of cloth (2), and rabbit fur (6).

Nests are usually so situated in thickets, tangles, or forks of a tree, that exits via suitable branches, stems, or rough bark are available. The availability of suitable avenues of escape may be a most important limiting factor in the selection of a nest site. Only one nest was found in a cavity of a hollow tree. This was at two miles east of Ribolt, Kentucky, in an apple tree. It was inhabited by only one individual that jumped from the tree when a stick was pushed into the cavity, which was about two inches in diameter and eight inches deep. The nest was lined with rabbit fur.

A nest (eight miles southeast of Flemmingsburg, Kentucky, January 18, 1951) was about eight feet above the ground in a thicket of honeysuckle. While attempting to reach the nest, five individuals escaped to the ground and none was caught. The nest was carefully kept intact in hopes that the mice might return and be collected later. The area was visited again two days later and the nest was almost completely torn apart, as if the mice were moving it, bit by bit, to some other location. A thorough search of this somewhat small, circumscribed area failed to produce another nest. The area was visited again a week later and there was still no evidence of a nest or any signs of the five inhabitants.

A large nest (five miles east of Vanceburg, Lewis County, Kentucky, February 10, 1952), nearly nine inches in diameter, proved on close inspection to be a feeding platform. It was saved for food study. When the nest was taken apart it was found to have been a brood nest, also. In the center of the nest, and about an inch from the bottom, four small young were found that had died only a day or so after birth. They seemed to have dried up or mummified soon after death. Apparently these mice had remained, dead, in this "nest" since the previous summer. On the top of these dead young mice was added another inch of shredded inner bark. A quantity of seeds and empty discarded seed-shells were present on top of, and in, the newly added inner bark. Many of the seeds and shells were fresh, and the inside of the "nest" was in good condition. Fresh droppings were also present, and it was quite apparent that the feeding platform was in recent and frequent use.

Another nest (five miles east of Vanceburg, Kentucky) was found in a dense clump of

where these studies were made on golden mice in northeastern Kentucky.

honeysuckle. It was seven inches in diameter and four and a half feet from the ground. As the nest was approached, three mice were seen leaping from the nest and others may have made their exit the same way before the nest was noticed. This was the first time individuals were noted to leave a nest even before it was disturbed in the slightest. Examination showed that these mice were living in a feeding platform, which they had converted into a makeshift nest. A typical nest, which probably was the original nest of these mice, was about 20 feet away, but it had been partially destroyed. A heavy decayed mass of seed shells in the bottom of the nest was undoubtedly of the previous year's crop. On top of this heavy mass were many seeds shells from recent feedings.

A nest in a clump of honeysuckle (Crane Creek, 18 miles southeast of Flemmingsburg, Kentucky) contained four individuals. Just 15 feet away in another clump of honeysuckle there was a nest, of almost exact proportions, of a *Peromyscus leucopus noveboracensis*. This would indicate that there is little or no rivalry for food or nesting sites between the two. However, this was the only case where the two species were found so close together.

It has been found on a number of occasions that good nesting sites may be used year after year even though the nest is removed and its occupants taken. Nests and mice removed from a particular clump of vines or heavy brush in early spring may very likely be replaced before the coming winter. A nest (eight miles southeast of Flemmingsburg, Kentucky) was 15 feet up in a 30-foot cedar tree. The nest was in a crotch where several limbs converged. In March, 1950, it contained four individuals (2 males, 2 females), probably a family group. The nest and mice were removed. The area was visited again on January 18, 1951, and in exactly the same place another nest was noted. It also contained four mice, an adult pair, and two subadult females. This also was thought to be a family group.

A nest (Rodburn, Rowan County, near the old C. C. C. camp ground) was on a horizontal branch four feet from the ground. An immature dead mouse, judged to be about a month old, was found in the nest, on November 24, 1951. Since the mouse was unspoiled, it is believed it had been dead only a few days. This young mouse must have been born in the later weeks of October.

Nests containing individuals or family groups of mice have been found within 50 feet of one another. If suitable cover extends over a large area, the nests containing mice are generally much farther apart, and nests are seldom less than 75 yards from one another. In large areas where there is more than one family group nesting, it is believed that the feeding platforms may overlap several home ranges, and may be used by any of the individuals of the area. In other words, different families or mice, with different ranges, may share feeding platforms. In good cover it is not uncommon to see two or three feeding platforms within a radius of 30 or 40 feet.

In some areas, feeding platforms may be numerous, yet thorough search of the area will not produce a nest that is inhabited. From the droppings on the inside of the feeding platforms and the shells of freshly opened seeds, it is evident that they are in use and that mice are somewhere in the immediate vicinity. We have never found a nest on the ground, although search of such areas has been made. Some golden mice may nest on the ground if they can find a dry situation.

Although we have no figures, it is firmly believed that the home range is small and nightly forays are made only a short distance from the nest. It is necessary to set traps close to occupied nests to take specimens. When individuals have escaped from nests, those taken, and judged to be the escapees, were near the original spot.

Bird nests are frequently used as foundations for the nests of *Peromyscus nuttalli*. The two nests most commonly used are those of the eastern cardinal and the yellow-breasted chat. The habitat preferred by *Peromyscus nuttalli* is, most generally, the favorite nesting cover for these two species of birds. Feathers of those birds common in the area are used in the construction of nests of *P. nuttalli*. Cardinals, juncos, and towhees roost at night in the heavy clumps of vines that are also used by these mice. Feathers are lost in molt or when the birds are preyed upon. The predator will often eat its prey at the scene of the kill, discarding the feathers. These feathers may be used by any mice in the vicinity. Cardinal feathers are most commonly found in nests.

In midsummer, it is difficult to examine nests, for the thickets where the nests are situated are nearly impenetrable. However, nests examined in summer have been empty of mice. In the summer they may spend more of their time on the ground, and may have nests under logs and other debris on the ground. Such nesting sites might be far cooler in the summer than the completely closed, heavy nest in a bush.

FOOD

Numerous seeds are eaten by golden mice. In one large feeding platform (five miles east of Vanceburg, Kentucky), a part of the seeds were counted, and then by comparison and approximation, the entire number was estimated at 10,000. The shells or coats of these seeds were recovered from various feeding platforms. Nearly all the seeds had been opened by a narrow slit along their sides and the cotyledons removed. The mice must be exceedingly dexterous in holding and manipulating some of these small seeds (such small ones as *Galium* or *Trifolium*) in their front feet and adept with their incisors in opening the seeds.

The most preferred seeds were of sumac (*Rhus*). In all, 23 different seeds were eaten by these mice (Table 1). In some cases, the fleshy coverings of the seeds were probably consumed, but in nearly all instances, the cotyledons were eaten. Most of the seeds at the feeding platforms had been opened and eaten, but a small percentage were unopened, and may represent a storage for future use.

The cheek pouches in golden mice must be most important in transporting these seeds to the platforms. One specimen when being prepared as a skin was found to have six small seeds in its pouch. This animal had been in captivity for about 28 hours. We suspect that if mice could be captured on their way to the feeding platforms, many seeds would be found in the pouches. William K. Clark informs us (letter of May 14, 1952) that after holding four immature mice in captivity for three hours, one had the pouches fairly well-filled and another had a few partially-chewed pieces of green leaves. These mice were taken by him from a nest near Bosher's Dam, James River, Chesterfield Co., Virginia.

In all likelihood, golden mice in northeastern Kentucky also feed on items other than seeds. However, seeds must be the main staple, and fruits and green materials must be of much less importance. Furthermore, very little food must be eaten on the ground or away from the feeding platform.

In captivity, golden mice would eat a variety of items offered, including prunes, apples,

TABLE 1.—*Food eaten by Peromyscus nuttalli as determined from recovery of seeds at feeding platforms*

Most numerous	
Rhus, sumac	*Cornus*, dogwood
Prunus, wild cherry	*Smilax*, greenbrier
Average abundance	
Quercus, oak	*Phytolacca americana*, pokeweed
Polygonum, bindweed	*Desmodium*, tick clover
Ampelopis arborea, peppervine	
Least numerous	
Celastrus scandens, bittersweet	*Phaseolus polyslachoys*, wild bean
Bromus, brome grass	*Amphicarpa*, hog-peanut
Robinia, locust	*Psoralea*, scurf pea
Galium, bed straw	*Acer negundo*, box elder
Trifolium, clover	*Tilia*, basswood
Asclepias, milkweed	*Viburnum*, black haw
Zea mays, (field) corn	

TABLE 2.—*Number of mice taken from individual nests*

NO. ♂♂	NO. ♀♀	TOTAL NO.	LOCALITY (IN KENTUCKY)	DATE
2	2	4	Rowan Co., Rodburn	Jan. 18, 1951
1		4 (3 escaped)	" " "	" " "
3	3	6	" " "	Nov. 24, 1951
0	1	1	Carter Co., 10 mi. E Olive Hill	Jan. 18, 1951
0	1	1	Flemming Co., Crane Cr., 18 mi. SE Flemmingsburg	" " "
1	0	1	Flemming Co., Crane Cr., 18 mi. SE Flemmingsburg	Jan. 27, 1952
1	3	4	Flemming Co., 8 mi. SE Flemmingsburg	Jan. 18, 1951
1	2	3	Flemming Co., 8 mi. SE Flemmingsburg	Jan. 27, 1952
2	2	4	Flemming Co., 8 mi. SE Flemmingsburg	March 1950
1	2	3	Lewis Co., 6 mi. E Vanceburg	Feb. 10, 1952
	1	2 (1 escaped)	" " " " " "	" " "
1	1	2	" " " " " "	" " "
1	0	1	" " " " " "	" " "
4	0	4	" " " " " "	" " "
1	3	4	" " " " " "	" " "
1	3	4	" " " " " "	" " "
2	0	2	" " 1 mi. W Vanceburg	April 23, 1950
Ave. 1.4	1.6	2.94		

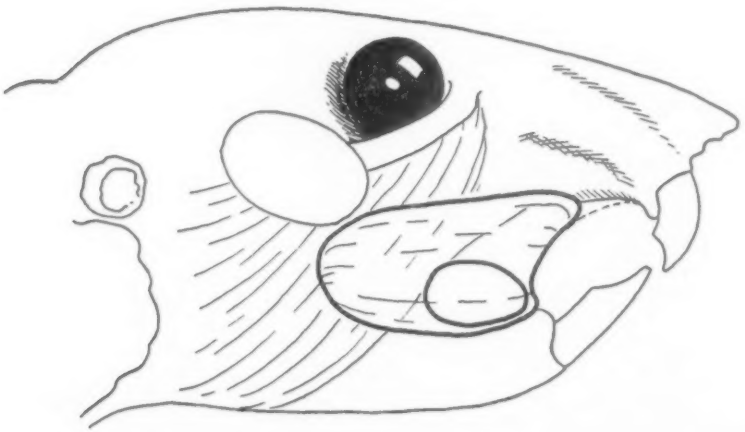

FIG. 2.—Head of *Peromyscus nuttalli nuttalli* with skin removed to show the position and extent of the thin cheek pouch. The inner dark circle represents the orifice of the pouch; the outer dark line the limits of the pouch extending from the lip backwards and over the masseter muscle. Specimen from Rowan County, Kentucky.

bird seed, dry oatmeal, cantaloupe seeds, cheese crackers, and oranges, but they seemed to prefer nuts, including peanut butter.

Peromyscus nuttalli have the best developed cheek pouches of any of the *Peromyscus* known to us. In 12 adult animals that were dissected, each had these pouches present. The structure is exceedingly thin, membranous, and transparent, and can easily be overlooked. Once located on freshly killed specimens, the pouch can be stretched to a length of about 15 mm., and the orifice is 4 to 5 mm. in diameter (Fig. 2).

The pouch appears to be just under the skin, but actually is under the platysma muscle and over the masseter muscle. It is chiefly over the *superficialis* portion of the masseter, but partially over the *medialis* portion. William K. Clark has also studied the cheek pouches in *Peromyscus nuttalli* in Virginia. He notes (letter of May 14, 1952) that in two specimens dissected by him the pouches were in contact with parotid and submaxillary glands before their positions were disturbed.

BEHAVIOR

Peromyscus nuttalli is probably the most docile of all the wild mice. Individuals make the most gentle pets. When a pair is taken from their wild environment and placed together in a cage, there is great excitement for a few hours. During this time they may jump against the cage in an effort to escape. Soon they go into hiding, under whatever nest material has been provided. The first night they thoroughly familiarize themselves with their enclosure and thereafter very little effort is made to escape.

By the first morning following confinement, the mice may be handled without fear of bite. They are most easily handled by the tail. However, this organ is extremely sensitive and sometimes hard to catch. As one's fingers approach the tail, the mouse generally flicks it out of reach before the fingers can close. The tail is used extensively in climbing and almost automatically wraps itself around any protruding object within the mouse's path as it moves about in its cage or in the vines and branches of its native habitat. It is, to say the least, semiprehensile. Individuals have been observed hanging almost at right angles to a branch with only the hind feet and tail as a support. By using the tail, the mice can stand upright on narrow branches. In one large cage, of about ten cubic foot capacity, with numerous branches intertwined throughout, mice frequently were seen to stand upright on pencil-thick branches and reach up or sidewise several inches for a suspended item of food.

When picked up by the tail, the forelegs are held downward and the hind legs spread wide at almost right angles to the tail and body. The body is held still and rigid. Some mice are more nervous than others, and if held by the tail for more than about fifteen seconds will relax their rigidity and start to climb back up the tail on to the hand. If the hold on the tail is not released at this time the mouse will most likely bite.

When a nest is placed in the cage, the mice spend all daylight hours sleeping therein. When a hand is inserted into the nest, the mice quickly come to attention and immediately investigate the disturbance. The ears are partially laid back and a defensive attitude taken. If the finger is pushed closer, the mice lower their heads but allow themselves to be touched or stroked. They seldom move or make any attempt to bite. If the intruding finger treats the animals too roughly, the mice will leave the nest chamber, or burrow down into the nest lining.

If a new golden mouse is introduced into the cage, the mouse seems frightened and will not get close to the individual or individuals in the cage. On one occasion when an individual was introduced into a cage with five established mice, it climbed to the top of the cage. The new mouse did very little moving about for almost two hours and avoided the family group of five even though they made no efforts to attack it. Gradually the new mouse worked its way to an area just above the nest where the others were hiding. So slow was its actions that it took nearly four minutes to move ten inches from this spot to near the nest entrance. It seemed to expect attack, but this did not happen. When it reached the edge of the nest, it slowly and easily slipped past the waiting mouse at the entrance and joined the others. Evidently it was admitted to the group, and thereafter could not be distinguished from the

others in any of their actions. On two occasions, an introduced animal apparently was not accepted and it lived separately from the established nest.

On one occasion, a deer mouse, *Peromyscus maniculatus bairdii*, was introduced into a large cage with four established golden mice. The *Peromyscus maniculatus* was never accepted. The deer mouse remained at the bottom of the cage and made little attempt to run the branches in the cage. Within ten minutes after the introduction, two golden mice were out of their nest and another in the nest's entrance. The two *Peromyscus nuttalli* began shortly to chase the *P. maniculatus*. The golden mice were so much more adept at running the branches and wire of the cage that they repeatedly overhauled and nipped at the deer mouse. Within minutes the deer mouse was bleeding from the nose and very slightly from the base of an ear. The pursuit ended shortly thereafter. The deer mouse made one or two convulsive kicks, and was dead. The golden mice retired to their nest and were not seen feeding on the dead animal. It was removed, but had it been left in the cage, it is possible that the golden mice may have eaten it, for there was an indication that they had started to eat the tail.

Nests were often collected that contained a surplus of either males or females (Table 2). Pairs were selected and placed in individual compartments of a cage. When another pair or individual was introduced, it would be most readily received if this new pair or individual had come from the original nest. If an individual male or female, from one nest, is placed in a compartment with a potential mate from another nest, the first mouse admitted to the cage generally takes over the nest. By the following morning the two so paired are always in the nest together.

In captivity, golden mice can move through and over branches with great speed and dexterity. In a large cage with numerous branches, the mice established "paths" or preferred trails. One main branch was nearly 2½ inches in diameter and was relatively smooth-barked. This branch was at a 45 degree angle, yet the mice raced up and down it so fast at times that the eye could hardly follow them.

In an attempt to determine which of the sexes was the most nervous, three nests, high in vines, containing mice were shaken to see which sex would emerge and jump first. The first mouse captured in each of the three cases was a female.

REPRODUCTION AND DEVELOPMENT

Females that were pregnant were recovered in March, April, July, and October. We surmise that young may be born at any time during this eight month period (March through October). Since the gestation period is 29 to 30 days, and since the female is impregnated shortly after parturition, the next day in one case, a mature female golden mouse potentially could have seven or eight litters each year. The number of young at birth is two or three. Short, dark brown hair appears on the fifth or sixth day over the back and hips. The eyes open sometime between the 11th and 15th day (Table 3). After that time, the young freely move about the cage, and with little effort.

In captivity, it was customary to remove the male from the cage of the female as soon as signs of pregnancy were noted or as soon as the young were born. In one cage, the male

TABLE 3.—*Data on young of Peromyscus nuttalli*

DATE OF BIRTH	NO. IN LITTER	DATE AND DAYS EYES OPENED
March 11, 1949	3	March 24 (13)
March 20, 1949	3	April 2 (13)
March 30, 1949	3	April 10 (11)
March 30, 1949	2	April 11 (12)
March 25, 1950	3	April 9 (15)
April 21, 1950	2	May 4 (13)
April 23, 1950	2	May 6 (13)

was left in the same cage overnight with the female and three young. The young had been born sometime during the night. Early the following morning, March 25, 1950, the male was removed as soon as the young were noticed. On April 23, 1950, this female gave birth to two more young. This would indicate that the female was impregnated immediately after the first litter was born and the gestation period in this instance was 29 days. At the time the second litter was born, the sole surviving young from the litter of March 25 was well-furred, agile, and able to care for itself.

In another instance, the male was left in the cage with a female a full day after young were born on March 31st. On April 24th the female died. On dissection, it was noted that she contained three embryos that were almost full term.

The behavior of the male in the cage was distinctly different after the birth of the young. Up until this time the male and female were close companions in the nest. After the young were born, the male became very nervous and made every effort to escape from the cage. He no longer went into the nest, but remained in a corner of the cage or climbed about looking for an exit. At no time did the female make any attempt to drive the male from the cage while they were watched. When the male was removed and placed in another cage, he soon settled down and no longer tried to escape.

Young frequently were born in the empty, field-taken nests of *P. nuttalli* that were inserted into a cage. The female hovered over the tiny young. When she was forced to leave the nest, the young held to the teats and were carried along. Since her departure was deliberate, not hasty, the young were seldom jerked or bounced as is so often the case with *Microtus* and other *Peromyscus*. On occasions, a young would loose its hold and become detached. The female would immediately but gently grasp it, stomach side up, in her mouth and carry it with her. If possible, she generally brought the young immediately back to the nest. If a hand was inserted into the nest, the young could easily be taken from under the mother. She made no attempt to bite. If the young were again placed in the cage she immediately carried them back into the nest and brooded over them. The holding was always done from the stomach side and the hold was properly adjusted by manipulation with the front feet.

At birth, there is considerable variation in the size of the young, as attested by these measurements of total length. One was 37 mm. long, another 50 mm., and a full-term embryo was 49 mm. The young born April 21, measuring 50 mm. in total length, was 54 mm. long on April 24, and 58 mm. long on April 26. As it lay in its nest, under the female, there was a constant twitching and jerking of its legs. When touched with the finger or a pencil, the young kicked and jerked more vigorously. The umbilical scar was well healed, with only a tiny scab the size of a pinpoint by the sixth day.

Shortly after the eyes are open, the young move about the cage, are gentle to handle, and nibble at the fingernails. At this time they start to eat some of the softer foods placed in the cage for the female.

On two occasions, females with litters died before their young were old enough to eat and care for themselves. These young were placed in cages with other females that had litters. They were readily received and adopted. In one instance, the adopted young was considerably larger than the individuals of the original litter, but this seemed to make no difference to the female. A few days later, this female died and the adopted young stuck its head through a small hole into the adjoining cage of the male. It was bitten through the skull and killed.

On one occasion the female died when the young were only a week old. These were successfully raised by hand. A small doll's bottle was used to feed diluted condensed milk for a few days. As soon as the eyes opened and the young emerged from the nest, small pieces of bread soaked in milk were consumed and slices of oranges also were readily taken.

SANITATION

Nests were kept clean and seldom were droppings found within them. In captivity, the animals had a regular station for urination and defecation on the bottom of the cage and

well-removed from the nest. There were some ectoparasites in the nest, including fur mites and adult and larval fleas, *Orchopeas leucopus* (Baker).

In spite of cleanliness of the nest chamber, it appears that frequently dead mice are allowed to remain therein. In one nest, in use, young mice, recently dead, were found. In another nest, no longer in use, several mummified young were found. In captivity, an adult that died in a nest inhabited by three other adults was allowed to remain there. The odor from the decaying animal attracted our attention and it was removed.

METHODS OF CAPTURE

In northeastern Kentucky, few specimens can be obtained by using traps. Probably the mice do little foraging on the ground. The territory of the golden mouse must be thought of as a three dimensional one—width, breadth, and *height* in and through the brush and branches of trees.

The most effective method for securing specimens, in our experience, is to encircle any nest with the hands. To get within reach of the nest may be difficult at times because of thick tangles of vines. A quick grab with both hands around the nest should prevent the escape of any of the occupants. The nest should be carefully opened to ascertain if mice are present. We prefer to replace the nest, as nearly intact as possible, in the original spot for possible future occupation. As a rule, the mice inside a nest are quiet and appear unafraid. However, in some cases, individuals will leave the nest and jump to the ground at the slightest movement of a twig around or near the nest. The entrance to the nest generally is plugged and hard to see. When the mouse jumps from the nest, it seems to make no difference where it lands. On two occasions, when the nests were near the bank of a stream, the escapees landed in the water but swam swiftly to shore. Should a nest be along the side of a rough-barked tree, the mice will readily climb up the trunk and sometimes go to the topmost branches in an attempt to hide and secure safety. Once on the ground, the mice are most surely lost to the collector. Even though their movements are rather slow, their coloration is so concealing on the ground that they escape among the leaf mold or among the roots.

SUMMARY

In northeastern Kentucky, the preferred habitats of golden mice, *Peromyscus nuttalli*, are the thickets of honeysuckle, greenbrier, blackberry, wild grape, dogwood, and water beech, with a few pines and hardwoods interspersed. Such thickets are found in the valleys between the more heavily wooded ridges. In such habitats, golden mice occur northward to the very edge of the Ohio River in Kentucky, but not on the opposite shore in Ohio, although the habitat is essentially the same there. At the present time, the Ohio River is so wide that it must be an effective barrier to the spread of these mice.

Two types of nest-like structures are built: nests and feeding platforms. Both are above the ground and situated in bushes or trees. The nest has an inner, downy lining, usually consisting of feathers, fur, or milkweed "down". The outer part of the nest may be an abandoned bird's nest, which has been covered or capped over, and to which has been added leaves, grasses, or inner bark, in such a way as to shed the rain.

Nests are usually from three to ten feet above the ground and approximately 8 inches in diameter. Several mice (both males and females) usually occupy such nests, and may represent family groups. Nests are usually 75 or more yards apart. However, the home range of a golden mouse is believed to be small. The home range must be considered as three dimensional—length, width, and height in and among the branches of trees and bushes.

A good nest may be used for several generations, and a good nesting site may have a succession of nests built on it, if the nests are removed. In some cases, feeding platforms may be converted into nests, or nests may be abandoned and converted into feeding platforms. Nests usually have the entrances closed; feeding platforms have an entrance, and sometimes an exit, open.

Feeding platforms are approximately six times as numerous as nests. They always contain a large number of seeds from which the cotyledons have been removed through a narrow slit along the sides. The most frequently eaten seed was that of sumac (*Rhus*). One feeding platform may have as many as 10,000 opened seeds. The thin, membranous cheek pouches must be important in transporting these seeds to the feeding platforms. The agility of these mice to balance on narrow branches and the semiprehensile nature of the tail enables them to readily reach for seeds in bushes.

In captivity, these mice are social and will accept into their nest another golden mouse introduced into the cage. The acceptance is most rapid if the introduced animal is from the same nests as the other mice. Golden mice will not accept into the nest mice of a different species.

Young are born between March and October; the gestation period is 29 to 30 days; the litter size is two or three; eyes open between the 11th and 15th day; the young can move about the cage shortly after the eyes open. The mother broods the young in the nest; if forced to leave the nest, the young may be gently dragged along by hanging on to the teats. After birth, the parental male remains outside the nest.

Golden mice may be captured by grasping the nest with the hands, gently opening it, and removing any occupants. Properly replaced nests may be reoccupied.

6014 Kellogg Avenue, Cincinnati, Ohio, and Museum of Natural History, University of Illinois, Urbana. *Received November 18, 1952.*

OBSERVATIONS ON THE DORMANT PHASE OF A FEMALE BLACK BEAR

By J. R. Matson

From time to time, cooperative friends report dormant bears (*Ursus americanus*) found in their vicinity. In the present instance thanks are due to Wm. P. Irvin of Big Run, Pennsylvania, for notice that Harold O. Guiher of Sabula, Pennsylvania, had found a den in what is locally known as the Winterburn Area in Clearfield County, Pennsylvania. This is an extensive region of cut-over lands on which a deciduous second growth predominates, wild fruits, especially grapes, being prevalent in the vicinity.

The den, within sight and sound of traffic on Pennsylvania Route 255, was situated within 100 yards of the height of land, at an altitude of about 2500 feet, on a slight grade with drainage northward to the headwaters of Bennetts Run, a tributary of the Susquehanna River's West Branch. Due to Mr. Guiher's keen interest and co-operative attitude, and to the accessibility of the site, here was an opportunity such as is seldom encountered to observe the entire dormant phase of a black bear. Essential developments to be noted and recorded were suggested to Mr. Guiher. How well he executed the program is best told by his notes which follow: (Remarks by the writer are enclosed in parenthesis.)

"December 5, 1951. While hunting deer in Clearfield County, Pennsylvania, about 6 miles north of Dubois on Route 255 I found a bear in a cavity under a log. Temperature 44 degrees, no snow on the ground. Condition of the earth indicated that the hole had been dug months or possibly a year ago. The recess had been cleaned out recently. The entrance, running from north to south, was a hole about 16 inches in diameter and about five feet long from the outward end to a transverse cavity, running east and west, about four feet long by eighteen inches in width and depth. I made some inquiries from which I assumed that the bear is a pregnant female which accounts for denning so early.

(Mr. Guiher's reasoning here seems to derive from the popular belief that pregnant females retire earlier than males. It has been demonstrated that dormancy in male or female is induced by satiety and obesity. In years of bountiful food supply (and the supply of 1951 was phenomenal) bears enter the dormant phase earlier than in lean years. Dormant bears have been noted in Pennsylvania in late October and early November. Weather records for the area show freezing temperatures and snow on the ground during the last week of October and the first ten days of November, 1951. It is probable that under the prevailing conditions this bear may have occupied the hole for days or weeks prior to discovery by Mr. Guiher.)

"December 6, 1951. When I entered the hole she made no fuss—just raised her head and looked at me. Temperature 50 degrees, light rain, no snow on ground.

"December 8, 1951. The bear is in such position that I could not focus the camera, just put it in the hole and snap a flash bulb at three or four feet. For me it was quite an experience to come face to face with a bear. It doesn't seem possible she would let me get that close. Temperature 45 degrees, light rain, no snow.

"December 11, 1951. Tracks made in mud since the eighth show she has been going in and out of the den. Temperature 24 degrees, no snow. (More activity shown in mild weather.)

"December 15, 1951. Acts just as before—raises her head and looks at me. Took a couple pictures inside the den. From December 13th to 19th temperatures ranged from 13 to 32 degrees, with alternate rain and snow. Depth of snow today eight inches.

"December 22, 1951. Resting quietly today. On my approach she opened and closed her eyes as though very sleepy. Temperature 14 degrees, nine inches of snow.

"December 26, 1951. She had reversed her position in the den. She has not been coming out of the hole lately. Temperature 25 degrees, depth of snow 12 inches.

"December 29, 1951. Temperature 29 degrees, depth of snow 12 inches. She has reversed her position again with her head to the west. It seems that just before a storm she turns around with her head to the southeast. (Probably coincidence.)

"January 4, 1952. Warm weather and rain the past few days. There was about an inch of old snow on the ground and about four inches fell on the 3rd. When I visited her today she had been out of the den. She had walked north about 15 feet then took a couple steps to the east. A few hairs on the snow indicated she had scratched herself, then went back in. Evidently her cubs were born soon after, during the night of the 3rd, as I could hear squeaks, like little pigs. I could not see the cubs as she kept them closely covered. Temperature 20 degrees, depth of snow 5 inches.

"January 8, 1952. Tried to get pictures of the cubs, but she would not let me see them very well. Could see only parts of them. They look like little tan colored pigs about the size of a rat. Temperature 19 degrees, depth of snow five inches.

"January 11, 1952. Took more pictures but still could not get a good view of the cubs. The mother bear just looks at me. The cubs are turning brownish red color. Put two ears of corn in the den. Temperature 21 degrees, depth of snow four inches.

"January 12, 1952. Took more pictures today. Couldn't see the corn I put in yesterday. Don't know whether she ate it or merely pushed it back out of sight. Put some apples in today.

"January 15, 1952. The cubs look like little dogs. Their fur is now brown, smooth and shiny. Their feet are pink and like a human baby's.

"January 19, 1952. No change. She just looked at me. The cubs seem to be cold. She keeps them warm by lying on her side with her hind legs well forward, forelegs, head and neck over the hind legs. Sometimes you can see all four feet up by her neck. When she raises her head and the cubs feel the cold air they make considerable noise. They don't give her much rest.

"January 28, 1952. Cubs growing fast—fur getting darker.

"January 31, 1952. Not much change. She just raised her head and looked at me.

"February 3, 1952. Sleeping well today. I had to holler to get her to raise her head so I could see the cubs. Their fur is getting darker.

"February 10, 1952. The mother bear has turned around and put the cubs to the back of the den. Could see neither the corn nor the apples that I put in on February 8th.

"February 12, 1952. The mother bear has turned around facing the front of the den. The cubs were lying on and between her forelegs so when she raised her head we got some pretty good shots. Not so cold today so she let them out that far. We noted that both eyes of one cub were fully open. The right eye of another was fully open while the left was but partially open. So far as we know there are but two cubs."

(On visiting the den with Mr. Guiher on February 12th we noted tracks in the snow indicating that a party of four persons had discovered the site which up to that time had been a closely guarded secret. Assuming that curious or lawless persons would disturb or destroy the bear family we decided to call on the authorities for special protection. Local officials responded at once. The site of the den, on private land, was leased from the owner. A "game sanctuary" was established, the area was surrounded by wire and patrolled by deputies. During ensuing weeks several curious and malicious persons were arrested for violation of the sanctuary. Regrettably, this action of the authorities was severely criticized by certain individuals who branded it as a scheme to collect fines. Game Protector Kelsey and his deputies deserve credit for prompt and efficient action which prevented disruption of the bear family and made it possible for Mr. Guiher to continue his observations.)

"February 17, 1952. She just raised her head and looked at me.

"February 18, 1952. The game wardens have been guarding the den every day. They haven't reported any changes.

"February 20, 1952. She is lying in the same position but is more active.

"February 22, 1952. She has turned around in the den.

"February 23, 1952. She has turned back to her previous position facing the entrance. She is lying on her left side and lets the cubs out on and between her forearms.

"February 24, 1952. She has been out of the den far enough to put her forepaws in the snow. This is the first time she has been out since the cubs were born. The cubs walk around in the den and could see their footprints in the edge of the snow at the entrance. It appeared that they had been digging in the snow. Warm today. Temperature 42 degrees.

"February 26, 1952. Could see bits of corn cob at edge of den. She must have eaten the corn I put in. The cubs are lively. Their fur is almost as dark as the mother's.

"March 3, 1952. Snow on the ground—and cold. Cubs are pretty big now. She wouldn't let me see them today. She has enlarged the den compartment somewhat, pushing dirt and bits of corn cob and sticks to within a foot of the entrance as if to close the hole somewhat. When it is warm she does most of her moving around—or just before a storm.

"March 4 and 5, 1952. Snowing, raining and freezing these last two days. Lowest temperature 10 degrees.

"March 8, 1952. Snow on the ground. Cubs' fur is dark. They must weigh at least five pounds each. When I snapped a picture the flash bulb exploded with a loud bang. I thought sure she would come out, but it didn't seem to bother her much. She just looked kinda mad. Today is first time I've seen her stick her tongue out and lick the sides of her mouth. Am going to put in some honey and see if she will eat it.

"March 10, 1952. About four inches of snow on the ground today. Temperature 44 degrees. Took some pictures and had a very interesting experience. I gave her some honey, corn and potatoes. Had the honey in a plastic dish which I set in the entrance hole. The instant I put it there she scented it and moved her head up and down. I took a stick and pushed the dish slowly toward her. When it was well within the hole she came to it and licked the edge of the dish. I had stirred the honey with the stick that I used to push the dish. As I held the stick in my hand she licked the honey from it. I put two potatoes in and she smelled them. Then I put in two ears of corn, and she smelled that but continued licking the honey. She stopped licking honey and wouldn't touch it again. Sure is funny to have a wild bear eat out of your hand. Al was with me and he too thought it amusing.

"March 13, 1952. She had been out of the den, probably during the day, today. She ventured but a few feet from the entrance, evacuated the "fecal plug," then went back to the cubs. I collected the "plug" and expressed it to Cornell University, as requested.

"March 17, 1952. Fed her more honey today. When Matson was here the 12th I told him that she was getting used to me and didn't mind my fooling around her. He said that was all right for the present, but when the cubs got bigger to watch out. Well, now I know what he meant. I've been feeding her honey lately and just this minute got back from the den. Until recently she just smelled the honey and licked it a little bit but lately has been eating it better. This evening I offered her some honey on a stick about eight inches long. She took it from my hand, stick and all. Then I offered her some (honey) on a corn cob. She took a swipe at me and barely missed my hand. I don't think she did it to be mean. It just made her sore because I didn't give her the honey fast enough. Not much snow left. Temperature 42 degrees.

"March 23, 1952. Temperature 65 degrees. I visited the den and found she had left taking the cubs with her. She must have left not later than the 21st, as it rained on the 22nd, and no tracks showed in the mud today. Also I found another dropping which I collected and sent to Dr. Hamilton. This dropping had been rained on—so she must have left before the rain yesterday. No snow now, so I searched the woods to the northeast and found her a short distance from the den lying under some grapevines beside a tree. The cubs were trying to climb a tree nearby. They could go up about two feet. The old one was eating wild grapes that had fallen off the vines. She had torn an old stump apart. While the family was in the den we could never identify more than two cubs, and I was surprised to find she had three. She didn't make any fuss when I went to within ten feet of

the cubs. Two were on a tree and one on the ground. She didn't come at me when I took pictures of the cubs—just sat up and watched me.

"March 24, 1952. Went to the place where I left her last evening, but she was not there. We found her about half a mile farther out on the ridge. Temperature about 35 degrees. She tried to get the cubs under her but had some trouble keeping the three of them covered. They would squall and try to get under to keep warm. Two wardens were along, but I had them keep off to one side so she wouldn't be frightened. She just lay there while the cubs crawled over and around her.

"March 25, 1952. Went back today for more photos, but she had left. We hunted all day but found no further trace of her."

COMMENTS

Guiher's remarkable observations substantiate certain well grounded theories and demonstrate individual variation in other respects which may be summarized as follows:

In this case the date of birth is established as of January 3–4. This is three to five weeks earlier than other records in which the evidence is quite clear. Assuming the gestation period at the reported maximum of seven and one half months (225 days) impregnation must have occurred about May 22nd, whereas mating is believed to occur between mid-June and mid-July. A gestation period of about seven months is more generally accepted, in which case impregnation would have occurred in early June.

The fruiting season of 1951 was phenomenal in Pennsylvania as in the East generally. Adult bears taken in November, 1951, were very fat. Cubs killed illegally in November, 1951, and surrendered to the authorities were extremely large, specimens weighing 70 to 90 pounds being reported. The abundant food supply of 1951 suggests that the female in question may have retired to her winter quarters several weeks (four to six weeks) prior to discovery on December 5th.

Although instances of subterranean quarters have been reported by others, this den, apparently the work of another species (woodchuck or fox) and renovated by the female bear, was the first winter resting place *completely underground* and *actually occupied* by a bear observed by the writer in Pennsylvania or elsewhere.

It is interesting to note that this female was easily roused and undoubtedly conscious during the greater part of her dormant period; that while more active in mild temperatures she performed her functions at all times—this in contrast with the torpid condition of the true hibernators. When approached judiciously this individual showed neither fear nor animosity. The flash of impatience at the withholding of food is typical of the black bear at all times.

The taking of food, even in small quantities, while in winter quarters and immediately after, seems to be somewhat unusual. Stomach analyses have disclosed that, on resuming activity in early spring, bears normally eat little or nothing for days or weeks although foods of small value may be available. In contrast with the popular notion that bears on emerging from "hibernation" immediately take

quantities of water, this individual apparently remained on a dry ridge for at least two days after leaving her den.

The birth date of these cubs was definitely established as of the night of January 3–4. Their eyes were open on the 40th day, February 12. This confirms the accepted belief that the eyes open in about six weeks.

In this case the cubs were confined to the den for about 11 weeks (78 days), during which time they attained an aggregate weight estimated at 21 pounds, minimum. Assuming a maximum combined birth weight of three pounds (undoubtedly less), this represents a minimum increase of 18 pounds gained solely from the mother's milk. The marvel of this adaptation is apparent when we consider that the nutriment for this growth normally derives from the mother's fat reserve without intake of food or water. In this exceptional case the mother was artificially supplied, during the latter days of confinement, with an amount of food that would not constitute a single normal meal.

The bear in question was under continuous observation in her narrow quarters from December 5, 1951, until she left the den with her cubs, presumably on March 21, 1952—106 days. How long she may have been in the hole prior to discovery is not known. During this time her brief sorties from her underground retreat were plainly registered in mud or snow. As no excretions were in evidence either inside or outside the den, it is clear that no evacuation of the colon occurred between December 5 and March 13—98 days. This supports earlier findings that, during the dormant phase, digestion is suspended in the stomach and that the intestines are found empty and shrunken in typical cases. Specimens have been examined in which the abdominal cavity was so filled with fat as to preclude the ingestion of any considerable quantity of food.

In northern New England it is not unusual for bears to become dormant in late October and resume limited activity in April. Thus, the period of inactivity and suspended digestion may extend to five months. Available evidence indicates that, given a bountiful crop of mast, bears may cease feeding days or weeks *before* becoming dormant and eat little or nothing for days or weeks *after* activity is resumed in April and May. The period of fasting may extend to six months or more. In fact, following a bountiful crop of fruit and nuts, an early winter, and a late spring, bears have been found in prime flesh and fur in mid-June, with considerable remaining fat reserve, and with stomachs containing but small quantities of vegetation. This suggests that a period of indifference to food may extend to seven or eight months with no ill effect.

Whether the period of partial or complete indifference to food be shorter or longer, the accumulated residue in the lower colon, commonly known as the fecal "plug", is normally ejected when limited activity is resumed in spring. It is ejected almost instantly when the bear is routed from winter quarters by an intruder.

The so-called fecal "plug" has been described as a mechanical obstruction composed of foreign material designedly eaten by the bear to close the alimentary tract. Why the tract should require "closing" has not been made clear. The evidence suggests that the "plug" is a heterogeneous collection of material picked

PLATE I

UPPER LEFT: The underground den was located beneath the log in the center. UPPER RIGHT: The bear in the den before the birth of the young; photographed by using a flash bulb. LOWER LEFT: Mother bear in den with two cubs showing. Cubs about ten weeks old. Note dish used in feeding honey. LOWER RIGHT: Den cavity after bears had left. BOTTOM: Fecal "plug" dropped by adult bear on leaving den on March 13. Scale in inches.—Photographs of bear and den by Harold O. Guiher.

up indifferently, following the suspension of active feeding in fall, together with a residue of secretions, the conglomerate being retained during the inactive period. On what seems to be sufficient grounds we assume that in the case of females with newborn cubs the "plug" contains the excrement of the infants and foreign material picked up incidentally in the nest. The mother invariably keeps the nursery immaculate.

In the present instance we are indebted to Dr. William J. Hamilton, Jr., for the accompanying photograph of a fecal "plug" (Pl. I) and analysis. It was collected March 13, weighed 240 grams, neasured 186 mm. in greatest length and 147 mm. in greatest circumference; color, dark greenish black on the outside, cinnamon brown inside; composed of skeletonized leaves, fragments of bark, twigs, mosses, hair, and undetermined matter. A second specimen presumably was passed March 21 and was collected on March 23. The content of this specimen resembled closely that of the first.

Credit is due Harold O. Guiher for his substantial contribution to this record of little-known facts concerning the dormant phase of the female black bear, and to Conservation officials of Pennsylvania for their efficient cooperation.

Perry, New York. Received November 6, 1952.

AGING IN THE MASKED SHREW, *SOREX CINEREUS CINEREUS* KERR

By William O. Pruitt, Jr.

During the course of a microclimatic study of small mammal habitats in the vicinity of the University of Michigan Biological Station, near Cheboygan, Cheboygan County, Michigan, a series of 31 specimens of the masked shrew (*Sorex cinereus cinereus* Kerr) was collected from one study plot in a trapping period of six consecutive nights, from July 9 through 14, 1951. This study plot was at the north end of Burt Lake, in a portion of the extensive white cedar and spruce swamp known locally as Reese's Bog. These shrews were taken in 100 Museum Special traps gridded over the 300 × 400 foot study plot. The microclimatic data, as well as complete trapping results from this area and others in the same region, form the basis of separate reports which have been presented elsewhere.

Accurate criteria for establishing age are essential to an understanding of population dynamics or life history of any animal. In shrews, a number of characteristics have been used as age determinants; however, many of these are of doubtful value, and possibly none should be used alone. Pearson (1945) has reviewed the various methods for determining age and reached the conclusion, that, for *Blarina*, tooth wear, with some reservations, is the most reliable. Hamilton (1940) in his study of *Sorex fumeus* also used tooth wear to illustrate aging. Conaway (1952) used a summation of tooth measurements as an index of age in *Sorex palustris*.

In *Sorex cinereus* the tendency of the teeth to form well-defined wear patterns is much less than in *Blarina*. In this latter animal the wear progresses by a series

of step-like stages; one cusp wears to a certain level and then exposes a previously protected cusp. This is not so in *Sorex cinereus*. In this animal the teeth are shaped so that the wear progresses more or less evenly on all cusps, abrading the cutting edges down until a base level is reached, whereupon the ridges suddenly start to get blunt and to change from a knife-edge shape to a ridge with a superimposed groove which wears down into the ridge forming two more or less parallel low ridges. This progression of wear allows only four well-defined classes to be formed in this sample. These range from unworn through greatly worn. However, by noticing arbitrary check points of wear it would be possible to subdivide some of these classes. Such a division has been indicated in the figure. Another well-defined wear class might possibly occur. Such a class would come into existence in late summer and would be composed of individuals with an extreme amount of tooth wear.

Class 1.—Teeth unworn, W-shaped cutting surfaces of molars sharp and the ridges not blunted. The metacone-metastyle ridge of P^4 sharp and not blunted. Unicuspids sharp, tips not worn.

Class 2.—Cutting surfaces blunted, wear starting on the cusps as well as the intervening ridges. Metacone-metastyle ridge of P^4 somewhat blunt. Parastyle of P^4 showing wear, but the wear extending only to the base of metacone, or up the anterior edge, not reaching the tip. Unicuspids show wear on posterior side of tip.

Class 3.—Cutting surfaces worn blunt. Parastyle-metacone figure of P^4 worn to a continuous groove.

Class 4.—Cutting surfaces worn to base level with the main cusps weakly projecting. Metacone-metastyle ridge of P^4 worn to a straight line.

From an inspection of Figure 1 several salient features of *Sorex* growth and aging may be noted. The individuals in this sample may be divided into two main groups, not only on the basis of tooth wear, but by using several other criteria as well. These groups are (1) a great number of apparently young and middle-aged animals which compose my tooth-wear classes 1 and 2. The animals in this group form a quite closely knit unit, their various measurements falling very closely about a mean. The second group is composed of animals in my tooth-wear classes 3 and 4. There are nine animals in this group, two males and seven females. Of these seven females, one was gravid and three lactating. The two males had testes measuring 5 and 6 mm. long, respectively. No other females than these were reproductively active, and no other males had testes longer than 2 mm. Thus it appears that reproduction is carried on only by fully matured or old individuals—those whose tooth wear has progressed to the "base leveling" stage. This second group has other distinguishing characteristics. The individuals of classes 3 and 4 are much heavier and tend to be longer than the rest of the population. Not only the gravid and lactating females are heavier, which is to be expected, but the males as well, although not to such a marked degree. Figure 1 shows that in cranial depth, cranial width, and condylobasal length these individuals are smaller than the rest of the population. The length of the maxillary tooth row shows this phenomenon slightly, also. It is recognized that external

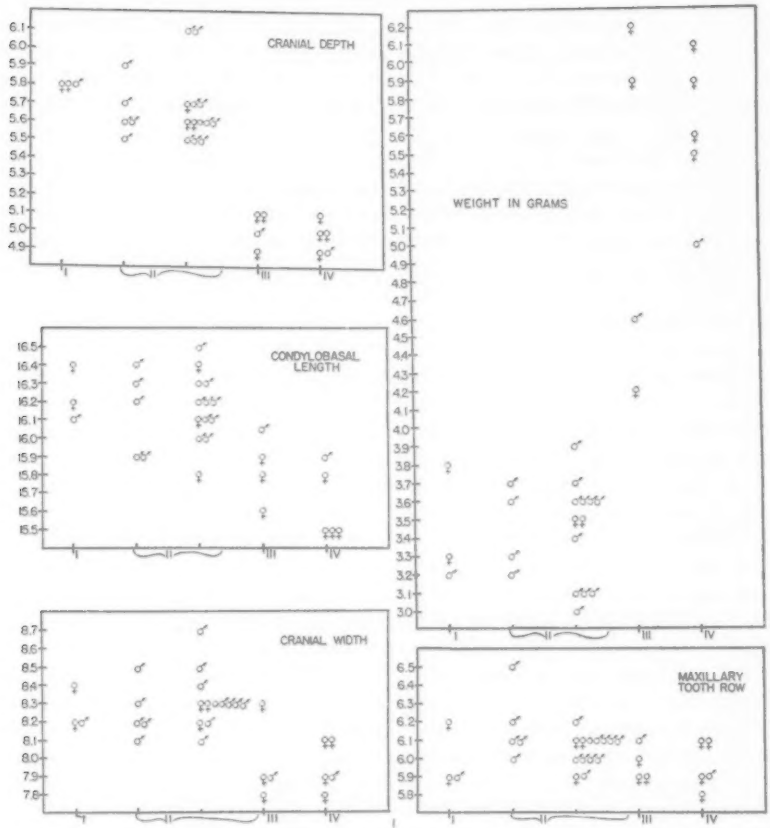

FIG. 1.—*Sorex* aging. Abscissae divisions are tooth-wear groups, ordinate divisions are millimeters or grams.

length and weight are subject to great variation, but we may say that, in general, these old individuals are longer, heavier, and with shorter, narrower, and more shallow skulls than the rest of the population.

Skull measurements, except for condylobasal length, which was taken with dial calipers, were made with a binocular dissecting microscope and micrometer ocular.

The phenomenon of smaller cranial size in old age has been noted in other animals by various authors (Augier, 1932; De Beer, 1937), but most mammalogists have observed that shrew skulls become *broader* in old age. Warren (1942) noted that "The skull becomes shorter, broader, and flatter, the molars wear so as to appear broader, and the large middle incisors not only wear off in front but turn down at a right angle to the cranial axis." Jackson (1928) used a flattening of the

brain case as one of his shrew age criteria. He also recognized the existence of "runt" skulls in shrews. Quay (1951) noted not only a flattening but a broadening as well of the cranium in old age in *Sorex tundrensis*. Also, Palmer (1947) noted that an old post-breeding *Sorex cinereus* had a "thicker snout and broadened, blunt head . . . as compared to the younger ones." This broadening of the head might well have been due to an increase in muscle volume since we have seen that the skull itself may actually shrink with age. Augier (*op. cit.*) attributed the skull shrinkage in man to a decrease in volume of the brain itself with a corresponding erosion of bone from the external surface of the skull and a deposition of bone on the internal surface. However, he also noted that re-deposition of bone occurred more markedly in the facial region than in the neuro-cranium. In many mammals the process of aging is accompanied by the development of various ridges, protuberances, and crests on the skull. In extreme old age these ridges themselves may become eroded (Petrides, 1949). Possibly the phenomenon of skull shrinkage in shrews may be due to such erosion by muscle action since it is a common observation that hypertrophy of a muscle or muscle group is frequently accompanied by a corresponding erosion of bone in the region of the muscle. A common example of this action is the erosion of the scapula in the region of the infraspinatus fossa in some old, hard-worked horses.

Palmer (*op. cit.*) noted, in *Sorex fumeus*, a triangular area on the top of the skull that was not covered with muscle in immature individuals, but was covered with muscle in adults. It would be interesting to know if, in a single population of this animal, the old individuals possessed smaller skulls than the young ones, as is the case in this population of *S. cinereus*.

There are some ramifications of this problem of skull shrinkage that should be mentioned. In such short-lived mammals as shrews (18 months *fide* Pearson [*op. cit.*] for *Blarina*, about 13–14 months *fide* Hamilton [*op. cit.*] for *Sorex fumeus*), there may occur seasons when the entire local population is composed of one age class. For example, in late winter and early spring, before breeding occurs, the shrews of any area will all be "old" individuals, none having been born since the preceding summer. In early summer the population will be composed of two sharply defined groups, old and very young individuals, with markedly different sized skulls. In certain measurements these groups have no overlap or intergradation. These groups would be sufficiently distinct to tempt some systematists (not having specimens from every season of the year) to give each segment taxonomic recognition, with resulting confusion. Another possibility which might occur would be the taxonomic recognition of winter or early spring specimens from a particular region, if a sufficient number of summer and fall specimens had not been collected. This possibility is pertinent since Bole and Moulthrop (1942) have stated that winter pelages in shrews are less variable than summer pelages and are therefore of greater taxonomic value.

LITERATURE CITED

Augier, M. 1932. Crâne et cerveau chez le vieillard. L'Anthropologie (Paris), 42: 315–321.

Bole, B. P., and P. N. Moulthrop, Jr. 1942. The Ohio recent mammal collection in the

Cleveland Museum of Natural History. Sci. Publ. Cleveland Mus. Nat. Hist. 5: 83–181.

CONAWAY, C. H. 1952. Life history of the water shrew (*Sorex palustris navigator*). Amer. Midl. Nat. 48: 219–248.

DE BEER, G. R. 1937. The development of the vertebrate skull. Oxford, Clarendon Press. 552 p.

HAMILTON, W. J., JR. 1940. The biology of the smoky shrew (*Sorex fumeus fumeus* Miller). Zoologica 25: 473–492.

JACKSON, H. H. T. 1928. A taxonomic review of the American long-tailed shrews (Genera *Sorex* and *Microsorex*). North American Fauna 51: 1–238.

PALMER, R. S. 1947. Notes on some Maine shrews. Jour. Mamm., 28: 13–16.

PEARSON, O. P. 1945. Longevity of the short-tailed shrew. Amer. Midl. Nat., 34: 531–546.

PETRIDES, G. A. 1949. Sex and age determination in the opossum. Jour. Mamm., 30: 364–378.

QUAY, W. B. 1951. Observations on mammals of the Seward Peninsula, Alaska. Jour. Mamm., 32: 88–99.

WARREN, E. R. 1942. The mammals of Colorado. (Ed. 2). Univ. Oklahoma Press, Norman. 330 p.

Museum of Zoology, University of Michigan, Ann Arbor. Received December 3, 1952. (Current address: Arctic Aeromedical Laboratory, Ladd AFB, Fairbanks, Alaska)

SEASONAL ACCEPTANCE OF BAIT BY SMALL MAMMALS

BY HENRY S. FITCH

Intensive and long continued live-trapping of small mammals in localities of diverse habitats in the western, central, and southern states has impressed me with the importance of seasonal changes in bait acceptance. Certain kinds of small mammals such as shrews are notoriously difficult to trap, being indifferent to many of the baits that are commonly used. Others, which take bait well at times, may become indifferent to the same bait at certain seasons and in certain places, with the result that they are rarely caught, even though they are abundant. Under such conditions the trapper often may receive a false impression of a low population. I suspect that these seasonal changes are of general occurrence. Marked changes in trapping success probably are more often caused by change in bait acceptance than by change in actual population density of the animals. My experience with 14 kinds of small mammals, at three localities, in northeastern Kansas, central Louisiana and central California, is summarized in the following accounts.

OBSERVATIONS

Opossum (*Didelphis marsupialis*).—At the University of Kansas Natural History Reservation in northeastern Kansas a study of the opossum was initiated in October 1949, and since then 111 individuals have been trapped, marked and released. Study of the feeding habits at this locality (Sandidge, MS) has shown that the opossum is somewhat omnivorous, but that insects are by far the most important food source. In autumn, fruits make up an important part of the diet. In winter, the season of food scarcity, the opossum lives chiefly as a scavenger, utilizing such miscellaneous food sources as garbage and storm-killed, small vertebrates.

In late autumn, winter, and early spring, opossums can be trapped readily, and during this whole period—the colder half of the year—the weight declines and the physical condition of the average animal steadily deteriorates as stored fat is lost. The largest catches were recorded after unusually warm nights in the winter. Occasionally, individual opossums were found foraging in the daytime when there had been a sudden warming after days of subfreezing weather. During winter storms, opossums seem to remain inactive, and they fast for days at a time. By late April and early May they may have declined to half their autumn weights, and are then in critical condition and easily killed by exposure in traps on cool nights. In autumn, while still fat, they can tolerate lower temperatures and much longer exposure without apparent ill effects. As insects become abundant, with the advent of warm weather in May, opossums become progressively more difficult to trap. Trapping in summer, despite the fact that the population was then at its annual high, was so unproductive of opossums that it was discontinued. In this season of plenty, tracks and other sign frequently indicated that an opossum had passed near a trap without heed for the bait. Rapid deterioration of the baits (horse meat, either canned or fresh, meat scraps, lard, bacon grease, sardine oil, raisins, carcasses of small vertebrates) at high temperatures with frequent heavy rains and an abundance of carrion-feeding insects also handicapped trapping operations in the warmer part of the year. The total of 273 recorded captures were distributed by months as follows: July, 13; August, none; September, 4; October, 16; November, 25; December, 34; January, 35; February, 30; March, 43; April, 38; May, 30; June, 5 (Figure 2).

Short-tailed shrew (*Blarina brevicauda*).—On the Kisatchie National Forest in central Louisiana, in the fall, winter, and spring of 1947–48, collaborating with the U. S. Forest Service's reforestation experiments through direct seeding, I maintained lines of snap traps and live-traps baited exclusively with seeds of longleaf pine. Numerous small birds and mammals of kinds that are mainly insectivorous were trapped. Prominent among these species was the short-tailed shrew. In some situations it was caught in larger numbers than was any small rodent. The shrew caught in live-traps had gnawed the seeds in a characteristic manner making them easily distinguishable from those gnawed by rodents. Shrew damage was identified both in pine seeds artificially sown and in some which had fallen from the trees. The largest catches of shrews were made on nights with subfreezing temperatures. Even in mid-winter, periods of relatively mild weather brought a marked reduction in the catch of shrews. In spring, as insect life came into greater prominence, shrews no longer were caught except as rare accidents. It was evident that for these shrews as well as for other insectivorous mammals and birds, the pine seeds constituted an acceptable substitute food rich in fat and protein content and available at a time when invertebrates were relatively scarce and inaccessible.

At the University of Kansas Natural History Reservation, short-tailed shrews are abundant, but are rarely caught in mouse live-traps—only about one per thousand trap-days. In most instances, these captures are made when there are heavy rains. It is not clear whether the shrews enter the traps to feed on the grain bait or for some other reason.

Little short-tailed shrew (*Cryptotis parva*).—This shrew was also abundant on the Kisatchie National Forest in Louisiana where pine reseeding studies were made. *Cryptotis*, like *Blarina*, was trapped in large numbers with the pine seed bait in the coldest part of the winter, but this shrew rarely entered the traps at other times.

At the University of Kansas Natural History Reservation, *Cryptotis* is known to be common because many have been caught in pitfalls and funnel traps, but only one capture in a mammal live-trap has been recorded in many thousands of trap days. Since, on this occasion, the shrew ate a harvest mouse that was already in the trap, it probably was not attracted by the original bait.

California ground squirrel (*Citellus beecheyi*).—The seasonal trends in bait acceptance of this injurious rodent are of much economic importance. Effective control depends on a knowledge of its seasonal schedule of activity and feeding habits. A study at the San Joaquin Experimental Range, on the west flank of the Sierra Nevada foothills, resulted in

findings that probably would apply, in a general way, throughout the extensive range of the species (Horn and Fitch, Jour. Mamm., 27: 220–224, 1946; Fitch, Amer. Midland Nat., 39: 513–596, 1948). However, in other localities some allowance would need to be made for the effects of climatic and vegetational changes that occur farther north or south or that result from proximity to the ocean, or high altitude in mountain ranges.

In brief, experience in the year-round live-trapping of these squirrels on an 80-acre study area showed that the largest daily catches could be expected in late winter when the population was at its lowest ebb in the annual cycle. Successful trapping at this time of year is based on a combination of factors. The new green crop of annual vegetation on which the squirrels subsist is still short, and the squirrels, ravenously hungry after periods of

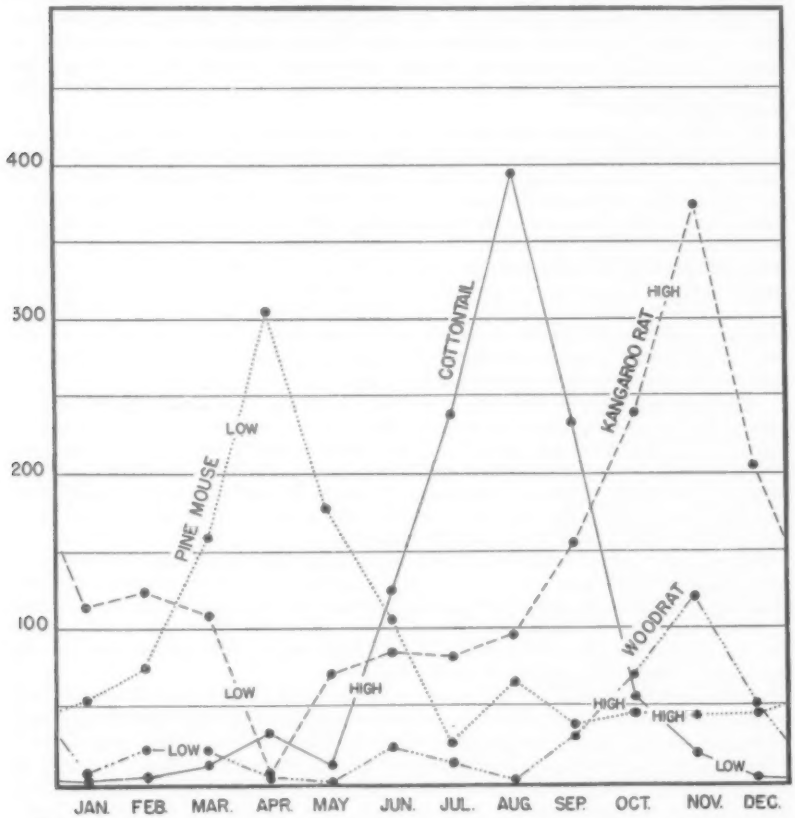

FIG. 1.—Variations from month to month in numbers of live-trap captures for four kinds of mammals, with fairly constant year around trapping. Data for three years are combined for each species; cottontail, and kangaroo rat (females only) at San Joaquin Experimental Range, Madera County, California, 1939, 1940, 1941; woodrat at University of Kansas Natural History Reservation, late 1948, 1949, 1950, early 1951; pine mouse, at same locality 1950, 1951, 1952. Approximate times of maximum and minimum population densities in the normal annual cycle are shown for each species.

dormancy, must concentrate their foraging in the mid-day hours of greatest warmth in the short winter days. With the onset of warm spring weather, in March, as vegetation makes rapid growth and food becomes more plentiful, squirrels become more difficult to trap. By late April the annual forage crop has matured and the squirrels have grown fat on it, doubling their winter weights in extreme cases. Acceptance of grain bait is then at its lowest level. Within a few weeks the daily catch will have tapered off to perhaps ten per cent of its late winter peak—this despite the fact that the active population has been increased several fold by the appearance above ground of the annual crop of young squirrels. The young feed upon the same natural foods used by the adults. On the trapping area, however, they were individually much harder to catch than the adults, and were never represented in the trapped sample in their true ratio. They may have been less inclined to feed upon hard foods such as the grain bait. Perhaps the chief factor was the previous conditioning of the adults to the grain bait at other seasons; consequently they were apt to take it occasionally even when preferred natural foods were available. After the vegetation dries out in May, dry seeds make up a large part of the natural food and the squirrels take grain more readily.

Kangaroo rat (*Dipodomys heermanni*).—On an 80-acre area of the San Joaquin Experimental Range, kangaroo rats were trapped alive every month in the year. Trapping success varied a great deal from one time of year to another (Fig. 1). The trends in each of three years were similar, although the population level fluctuated markedly from year to year. As was the case with the ground squirrel, bait acceptance by these rats was poorest in April, and for the same reason. Abundance of plants with maturing fruits and seeds, notably filaree (*Erodium botrys*) provided the rodents with a food source much preferred to any artificial bait. At this season each year the daily catch declined steadily to a small fraction of its early spring level. After the drying out of the chief forage crop in May, kangaroo rats were caught in increasing numbers as bait acceptance rapidly improved and the population was augmented by continued breeding through the summer and early fall. Bait acceptance was excellent during winter and early spring.

Jumping mouse (*Zapus hudsonius*).—At the University of Kansas Natural History Reservation jumping mice have been caught from time to time but they are not common, and their usual indifference to grain bait causes them to seem scarcer than they actually are. In the University of Kansas Natural History Museum there is a small series taken in snap traps at various times and places near Lawrence, Kansas. Collection dates of these are as follows: May 1, 1948—2 animals; May 4, 1948—6; May 7, 1949—1; May 7, 1950—1; May 16, 1921—1; May 16, 1950—1; July 15, 1922—1.

It is noteworthy that 12 of these 13 were collected in early May when they must have only recently emerged from hibernation. Natural, preferred foods such as seeds and herbaceous vegetation in general seem to be relatively scarce at that time of year. In more than 30,000 live-trap days on the Natural History Reservation, only nine captures of jumping mice have been recorded—on April 24, 29, and 30, 1952; June 7, 1951; June 8, 1950; June 24, 1952; July 4, 1950; and September 13 and 28, 1951.

For 24 more *Zapus* taken on the Reservation by methods other than with baited mouse live-traps, the seasonal distribution was as follows: early June, 2; late June, 2; early July, 1; late September (14-30), 6; early October, 8; late October, 5. Several of these were drowned in pitfall traps that filled with water during heavy rains, but most of them were caught in wire funnel-traps set for reptiles, along hilltop rock-ledges at the edge of woodland. These records suggest that the jumping mice move from nearby grasslands at the onset of cool autumn weather to rock ledges where it is presumed they are in search of suitable places in which to hibernate.

Deer mouse (*Peromyscus maniculatus*).—At the San Joaquin Experimental Range on the 80-acre area which was intensively trapped for kangaroo rats, many *Peromyscus* were caught, recorded, marked and released in 1938, 1940, and 1941. From October until mid-May, when there was green vegetation, the mice were caught most frequently, even though trapping at that season was less intensive and was often suspended in the coldest weather,

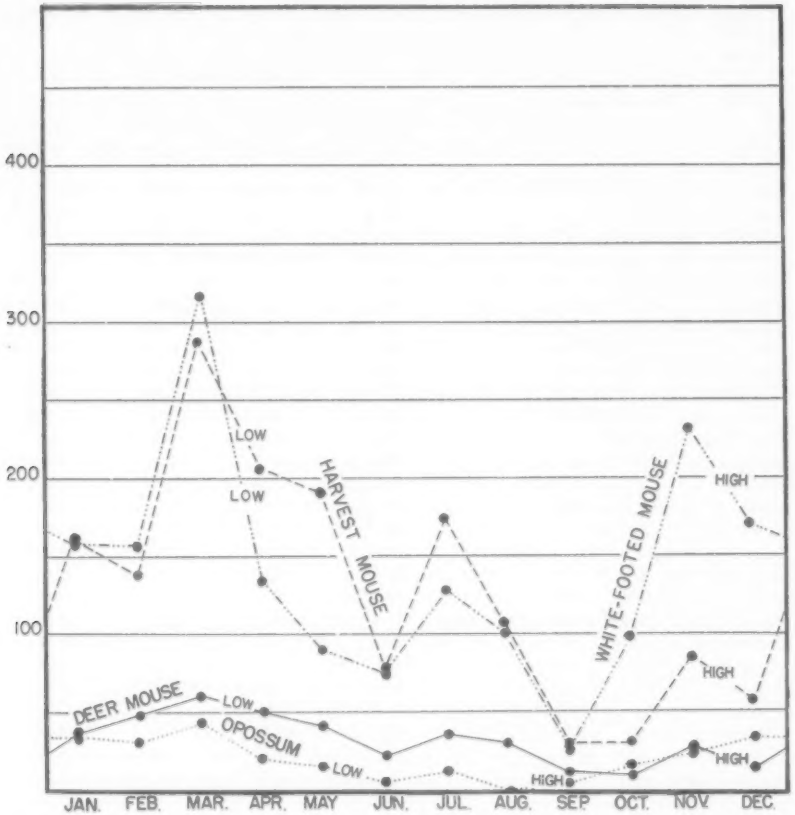

FIG. 2.—Variations from month to month in numbers of live-trap captures for four kinds of mammals at the University of Kansas Natural History Reservation; for each species, data are combined for three years (1948–1952).

in January and parts of December and February, to avoid mortality. During the dry season, May through September, deer mice were almost absent from the catch. Numbers of individuals caught in the different months were as follows: October, 9; November, 10; December, 24; January, 21; February, 27; March, 40; April, 2; May, 3; June, 0; July, 0; August, 1; September, 0.

At the University of Kansas Natural History Reservation, under different habitat conditions and climate, the seasonal trends were somewhat similar, but less pronounced (Fig. 2). From mid-November through May the daily catch, with a grid of one hundred live-traps in a three-acre grassland study plot, usually included several deer mice, but in the remainder of the year, summer and early autumn, fewer were caught (Table 1). In each of these instances it seems that the downward trend in numbers of deer mice caught in the warmer part of the year, did not correspond with an actual decrease in population. Rather, the population may have reached its annual high point within this period of minimum

TABLE 1.—*Fluctuations in average catch per day with a grid of 100 live-traps on a three-acre area, of four kinds of rodents*

TRAPPING PERIODS	AVERAGE CATCH PER DAY			
	Microtus ochrogaster	*Reithrodontomys megalotis*	*Peromyscus maniculatus*	*Sigmodon hispidus*
March 23–30, 1950	19.7	10.8	3.6	—
April 7–13, 1950	21.0	9.3	3.0	—
May 1–4, 1950	28.8	11.8	4.0	—
May 29–June 9, 1950	45.8	3.1	1.0	—
July 2–6, 1950	18.0	4.0	1.2	—
July 19–29, 1950	25.5	6.5	1.3	—
August 4–12, 1950	42.0	3.7	2.3	—
August 29–September 7, 1950	41.7	3.4	.4	—
September 21–27, 1950	33.0	—	.9	—
October 14–23, 1950	29.1	1.4	.3	.3
October 27–November 2, 1950	58.4	1.0	1.0	—
November 16–19, 1950	35.0	5.8	3.0	1.0
December 13–14, 1950	43.5	7.5	5.0	.5
January 9–13, 1951	23.8	5.5	4.6	—
February 5–12, 1951	21.3	7.3	4.3	—
February 25–March 2, 1951	32.7	10.2	4.5	—
April 4–8, 1951	35.6	15.4	3.0	—
May 6–11, 1951	59.7	15.0	3.0	.7
June 2–8, 1951	102.0	2.8	.6	2.0
July 20–27, 1951	69.9	4.6	.8	4.6
August 10–16, 1951	79.3	4.1	1.4	5.1
September 1–5, 1951	61.2	.8	.6	5.4
October 1–6, 1951	60.2	.3	—	2.3
November 8–13, 1951	39.5	3.0	.8	10.8
November 29–December 3, 1951	57.4	4.4	.8	11.6
January 9–12, 1952	33.5	12.8	1.8	6.8
January 17–20, 1952	49.8	10.3	.8	8.3
February 1–4, 1952	33.8	5.8	1.0	5.3
February 27–March 1, 1952	31.0	11.5	—	.3
March 20–29, 1952	25.8	3.8	—	1.9
April 24–27, 1952	53.8	6.5	—	—
May 14–22, 1952	49.1	2.8	—	1.0
June 13–22, 1952	29.6	1.8	1.0	.9
July 4–8, 1952	32.8	5.6	2.0	—
August 14–19, 1952	16.2	1.3	.5	—
September 4–9, 1952	23.2	1.8	.3	—

trapping success. In many instances, individuals caught frequently in early spring, but absent from the records for long periods during hot weather, reappeared in the traps at approximately their original locations with the return of cool weather in the autumn. A possible explanation is that these mice, being partly insectivorous in their feeding, are little attracted by grain bait at the season when insects are abundantly available.

White-footed mouse (*Peromyscus leucopus*).—At the University of Kansas Natural History Reservation this mouse has been caught in large numbers at all times of year and in a variety of habitats. Its presence often has interfered with trapping operations for other mammals or birds. Although it takes bait at all times of year it seems to enter traps with

grain bait most readily in winter, and especially in early spring (Fig. 2). A line of 102 live-traps operated at monthly or more frequent intervals for a year, made the largest catches in March, when two samples averaged more than twice the average for the 15 samples of the remainder of the year. All mice of this species caught in March were adults, and most of them were breeding—the population was then at its annual low point. Lowest catches were made in June, July, August, and September, and the five samples from within this period, corresponding with the annual high in the white-footed mouse population, averaged only 5.2—less than 27 per cent of the March average. The general abundance of invertebrates and plant food in summer may divert both this species and the deer mouse from grain bait.

Western harvest mouse (*Reithrodontomys megalotis*).—This mouse is moderately abundant on the 3-acre grassland area at the University of Kansas Natural History Reservation where a grid of 100 live-traps is set frequently throughout the year, and a well-defined seasonal trend is apparent. (Table 1 and Fig. 2.) The largest catches in both 1950 and 1951 were made in late February, March, April, and early May, but by early June the catch abruptly declined to a fraction of its former level. It was consistently low through the summer and even poorer in early fall. In the spring when best catches were made, the mice caught were almost all old adults, and this time was the peak of their breeding activity. Many females caught in April gave birth to litters of young in the traps overnight. The few harvest mice caught in summer included a high proportion of young, and it seemed that the spring population had been much augmented by this new generation. Thus, changes in the numbers caught were not at all indicative of trends in the population, but rather the season of minimum numbers corresponded with maximum trapping success and *vice versa*. In summer, preferred plant foods, probably certain seeds, divert harvest mice from the grain bait.

Pine mouse (*Microtus pinetorum*).—On the University of Kansas Natural History Reservation the pine mouse occurs in small numbers in scattered colonies. It was not discovered on the area until March, 1950, after nearly two years of trapping. Subsequently, special effort was made to catch and mark those of one colony confined to a narrow 150-yard grassland strip at the edge of woods near the Reservation headquarters. In two years 1155 captures were made of 106 individuals. The number of traps employed and the amount of trapping effort varied somewhat. Trapping was generally intensified at the times when results were most rewarding and was curtailed during the coldest weather. In each year, best catches were made in spring and the catch dwindled to a small fraction in the hotter part of the summer, even though the pine mouse population was then at an annual high. For the two years combined, total number of captures for each month were as follows: January, 53; February, 76; March, 183; April, 305; May, 176; June, 106; July, 26; August, 65; September, 37; October, 45; November, 44; December, 39.

Prairie vole (*Microtus ochrogaster*).—In the past two years at the University of Kansas Natural History Reservation, this vole has been caught in greater numbers than all other mammals combined. Most captures have been made on a three-acre grassland area with a grid of one hundred live-traps. At all seasons of the year voles were caught in substantial numbers each time the traps were set (see Table 1). Seasonal changes in bait acceptance were not as clear cut as they were in most of the other species studied. The thousands of records accumulated have not yet been fully analyzed. However, it is obvious that the population is at low ebb annually in December, January, February and early March. In winter almost all voles caught were adults or subadults. In this season the trap line was usually tended only once daily. In summer it was usually checked each morning and again in the late afternoon, so that the figures for daily catches in Table 1 are not entirely comparable between the two seasons. In view of the wide differential between winter and summer population levels, it appears that trapping success was much higher in the winter in proportion to the number of individuals present. From time to time traps were set outside the study plot and, in summer, catches on such new areas were generally meager despite abundance of vole sign. Successful summer trapping on the study area may have involved

long conditioning of the vole population there to the grain bait. This species fitted the pattern found in most other small mammals, in that individuals tend to take grain bait best in the season of food scarcity, corresponding with the annual low in population density.

A noteworthy trend in the vole catch was the progressive increase in numbers on successive days at the start of a trapping period. The catch was likely to be light on the first day after the trap line was set. As the voles discovered the bait at the set trap they tended to concentrate their activities there. For 29 trapping periods of 4 to 12 days each, including each month of the year, first, second, third and fourth days' catches average respectively, 68.6, 83.1, 94.3 and 114.6 per cent of the mean daily catch for each separate period. After the fourth day of a trapping period the numbers caught tended to level off.

Florida woodrat (*Neotoma floridana*).—This woodrat is moderately common on the University of Kansas Natural History Reservation. For the past three years traps have been set frequently wherever sign occurred on a 300-acre area, to catch and mark all the woodrats there. For the three years the total number of captures, by months, were as follows: January, 8; February, 22; March, 22; April, 5; May, 1; June, 23; July, 13; August, 2; September, 30; October, 68; November, 120; December, 50 (Fig. 1). These changing numbers reflect seasonal bait acceptance to some extent, although other factors are involved. Woodrats are most easily caught in autumn when they are at their annual high point of population density. Bait acceptance was excellent in winter, but relatively little trapping was done in December, January and February because of the danger of mortality in traps. In March, trapping effort was far less rewarding and the catch continued to decline to the annual low point in April and May. Catches in June and July were unduly costly in time and effort and consisted principally of immature woodrats. Presumably the abundance and variety of foliage and other plant foods tend to make the woodrats indifferent to grain bait during late spring, summer, and early fall.

Audubon cottontail (*Sylvilagus audubonii*).—This rabbit was live-trapped in large numbers at the San Joaquin Experimental Range, and of all the species of mammals studied, it provided the most clear-cut and striking example of seasonal fluctuations in catch. Trapping of rabbits on this area was incidental since the trap line was maintained for study of ground squirrels. Comparable data for each month of the year were obtained, although in winter and spring months rabbits were caught in such small numbers that it was impractical to maintain the trap line for them alone. On the 80-acre area, approximately 200 traps were kept set for several days each week throughout the year, and 228 rabbits were trapped a total of 1159 times (Fig. 1). "Throughout the growing season, October through May, while green food was abundantly available, rabbits only rarely entered the traps. It is assumed that natural foods were much preferred to the grain mixture of wheat and milo maize with which the traps were baited. In summer after the main forage crop had dried out, grain was taken freely, and nearly all recorded captures of rabbits were in the dry season—summer and early fall. Each year the catch was highest in August at the peak of the dry season. Trends were similar for all three years. . . ." (Fitch, California Fish and Game, 33: 160, 1947.)

In summer, when grain bait is readily taken, the natural foods available are of types high in fiber content and low in crude protein (Gordon and Sampson, California Agr. Exp. Sta. Bul., 627: 1-96, 1939). Vegetation consists chiefly of annuals that are dead and dry during the hot, virtually rainless summer, and the "growing season" begins with the advent of October rains. During the growing season, late autumn, winter and spring, the green plants have a high crude protein content. Like the ground squirrels living on the same area, cottontails attained their maximum annual weights in April or May when nutritious natural foods were most abundant. It is noteworthy that the seasonal trend of bait acceptance for this cottontail is exactly opposite from that of the deer mouse, with reference to the same bait on the same area.

Florida cottontail (*Sylvilagus floridanus*).—This rabbit is abundant at the University of Kansas Natural History Reservation but no comparable year-round trapping data are available as yet. In winter and early spring, the rabbits have often hindered the trapping

of mice by overturning many of the wire traps to obtain the grain bait. After killing-frosts in the fall, the rabbits feed partly upon dry foliage and partly upon the inner bark of shrubs and saplings. In the season of food scarcity, when the ground is covered with snow, bark is the principal food source.

In summer, grain is unattractive. For several weeks in June and July, 1951, two dozen traps were kept set along a woodland edge where cottontails were numerous, and various baits were tried. The few captures made were in traps that had been baited with green vegetables.

CONCLUSIONS

For 14 species of small mammals including a marsupial, two insectivores, nine rodents, and two lagomorphs, live-trapping data have been accumulated throughout the entire year or over periods of months. With every one of these species, success in trapping varied according to season. In some the seasonal difference in the catch was small. In others, seasonal change from a high incidence of success to complete failure was recorded. Even in the same locality species differed in the time and duration of maximum and minimum bait-acceptance. Varying success in trapping each kind of mammal at different times of year was found to have little correlation with the actual population level but was determined by the extent to which the animals were attracted to bait at any particular time. Baits are least attractive at times when natural foods are abundantly available, and are most attractive when natural foods are scarce. Best catches are most likely to be made at the season when preferred food sources are in short supply even though the population then may be at its annual low point. The annual maximum population ordinarily corresponds with a time of food surplus when animals tend to be indifferent to baits, and when adults attain their maximum weights.

In each species, bait acceptance tends to conform to the same seasonal pattern from year to year, altered somewhat by the population density and the food supply. For example, at the San Joaquin Experimental Range in the summer of 1939, drought conditions were unusually severe. The crop of annual vegetation was sparse and dried in early May. The few summer growing weeds, such as tarweed (*Hemizonia virgata*) which ordinarily provide some succulence in the dry season, were sparse and stunted. Under these conditions, ground squirrels, kangaroo rats, and cottontails were trapped much more easily than they were in other years.

At the University of Kansas Natural History Reservation in July, 1952, after weeks of nearly rainless weather, white-footed mice and harvest mice were caught much more readily than they were at that season in other years, but pine mice could not be caught at all.

Museum of Natural History, University of Kansas, Lawrence. Received October 31, 1952.

STATUS OF THE COATI IN ARIZONA

By O. C. Wallmo and Steve Gallizioli

The occurrence of the coati (*Nasua narica*) north of the Mexican boundary has been reported a number of times, but only in popular accounts has its significance as a member of the native fauna been given proper attention. The scientific literature conveys the impression that the coati is rare and infrequent north of the border. Actually, it has been an established resident of the mountains of southeastern Arizona and southwestern New Mexico for, at least, the last 30 years. Known records for the United States as far east as the Big Bend and Brownsville areas of Texas were summarized by Taber (1940).

Observations on which this paper is based were made incidental to regular activities under Pittman-Robertson Project 46-R, Arizona Game and Fish Commission, centered in the Huachuca Mountains, Cochise County, Arizona. During three years of work in that range it was found that the coati (known there as the "chula") is a well-established resident. The experiences of residents and of trappers and game workers indicate that the populations are greatest in Arizona in the Huachuca, Patagonia, and Tumacacori mountains, but that they are also frequently seen in the Santa Rita and Chiricahua mountains. Some recent evidence has been obtained that they are present in the Graham Mountains.

In the Huachuca Mountains they are so common as to have caused considerable controversy, resulting from alleged depredations on orchards and chicken houses and injury to dogs. Such complaints resulted in official removal of the legal protection that existed prior to 1950.

Despite the ease of observation of coatis, and their relative abundance in these areas, there is virtually no ecological data available from which a satisfactory evaluation of their position in the animal community can be made. Our limited studies, conducted during the course of other work, produced a small amount of information which is presented here.

The coati in southeastern Arizona is principally a resident of the wooded and forested mountains which rise abruptly above desert and semidesert plains. Sufficient records have been obtained to indicate that occasional erratic movements occur, but Taylor's (1934) statement that, "All of the records are for the Lower or Upper Sonoran Zones," while no doubt correct for his data, is somewhat misleading. The normal habitat is woodland and forest, largely in the Upper Sonoran and Transition Zones.

The sight records were obtained during 1949, 1950, and 1951. During that period a minimum of 128 coatis were seen. This is called a minimum figure because they were often seen in large bands in dense brush and only the actual number counted was kept, with an indication that others were present as evidenced by the noise they made in escaping. At other times animals were "flushed" but not seen through the brush. Their identity was then determined by tracks and other sign (Fig. 1).

There have been many extravagant statements made concerning the numbers

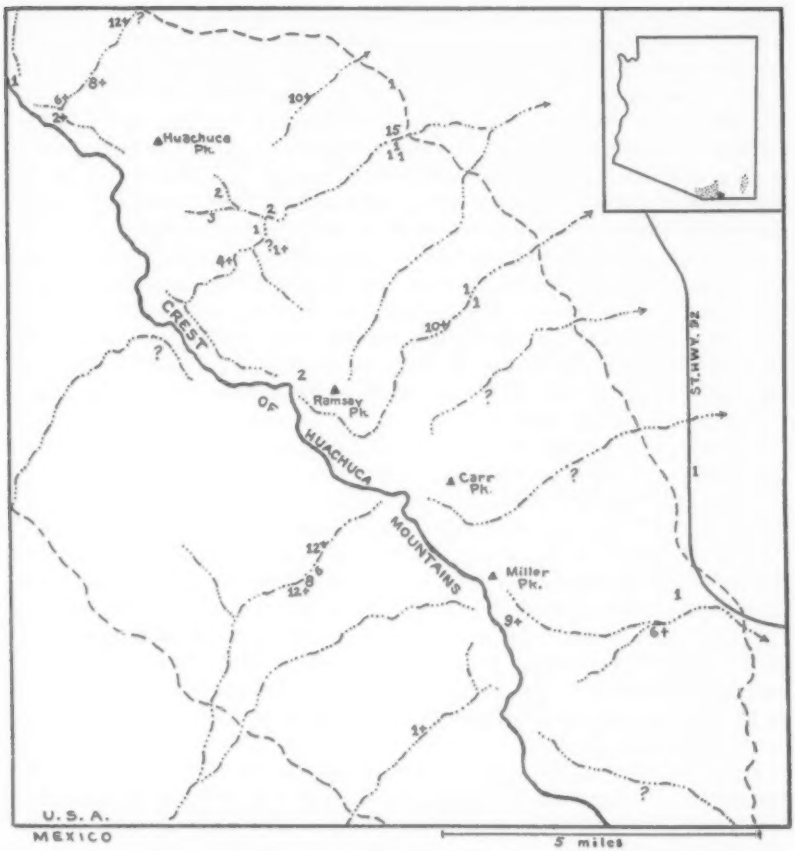

FIG. 1.—Locations and numbers of coatis observed in Arizona. Numbers followed by a + indicate that more were probably present but could not be counted. Insert shows the location of the area; the stippled portion represents the present range of coatis in Arizona. ---- Lower limits of coati habitat. ? Observations where a number could not be determined.

of coatis in the Huachuca and Patagonia mountains. Observations of large bands by numerous people contribute to a popular impression of great populations. This is probably quite misleading. The Huachuca Mountains are less than 20 miles long, and the coati habitat is no more than 10 miles wide except where the range joins the Canelo Hills on the northwest. The animals are active throughout the day and travel in noisy conspicuous bands. There is no evidence that these bands restrict themselves to circumscribed home ranges. Our experience leads us to believe that the bands are quite nomadic. Thus, it would not take a great number to cover the range and be observed in all parts of it.

On September 21, 1949, while doing deer-survey work with Mr. L. N. Goodding, we encountered an impressively large group of which we could count only 12 individuals. We estimated that that number could represent no more than a third of the animals in the band. The first impression gained was that the forest was full of the creatures—going up and down trees, over logs and boulders, crashing through the brush, with movement in every direction as far as the eye could penetrate the forest. Such experiences develop into tales of 50, 75, 100 chulas seen in bands by hunters. The greatest number that we accurately determined on a single occasion was 26, which incident is discussed later.

It has been generally believed that the coati is a recent addition to the fauna of southeastern Arizona. A collection in 1924 (Taylor, 1934) was considered to be the earliest definite record from the Huachuca Mountains. Recently Dr. D. F. Hoffmeister informed us by correspondence that in the files of the U. S. National Museum there is record that A. K. Fisher wrote of *Nasua* in the Huachucas in 1892 and referred to a skin in that museum (no. 19506) taken from Ft. Huachuca.

The lack of general knowledge of coatis in the Huachucas in earlier days, despite the fervid mining activity in the latter part of the last century and the early part of this one, may indicate that they were much less common than now. However, Mr. Marshall Ashburn, a local rancher, informed us that they were common in the Patagonia Mountains in 1914 when he obtained his first pet. If they were present in the Patagonia Mountains in 1914, they probably also existed in the Huachucas, as there is continuous habitat connection between the two ranges by way of the Canelo Hills. At any rate, it seems rather apparent that they have increased in abundance in recent years. Considering that the portions of the range of *Nasua narica* that lie within the borders of Arizona are peripheral extremes, it would not seem unusual for considerable population fluctuations to occur there and for their numbers to fall low enough to be rarely observed for long periods.

A number of extra-limital records for Arizona, in the Blue Range (Greenlee County), in the Santa Maria Mountains (Yavapai County), near Mormon Flat (Maricopa County), are far out of the present range and not connected by normal habitat. While it is proclaimed by some that coatis have been and still are increasing in the Border mountains, there is no evidence of their establishment in the above extra-limital areas. It is noted that both Taylor and Taber (*op. cit.*) overlooked the records for the Chiricahua Mountains in the extreme southeastern corner of the state. The presence of the species there was reported by Cahalane (1932). They still occur there and are occasionally seen, but they apparently do not exist in numbers comparable to those in the Huachucas.

In classifying our observations by habitat types we found that 11 observations (roughly 40 per cent of the observations and 54 per cent of the animals seen) were made in the lower canyons where there is a woodland consisting largely of oaks, sycamore, walnut, and often maple. In all of these cases water was not far distant. Nine of the observations (about 32 per cent of the observations and 30 per cent of the animals) were also in canyons but at higher elevation where the woodland is dominated by oaks and pines. Again, water was always present

nearby. Other observations were in pine forest, oak-pine woodland, high encinal (this term referring to a shrubby woodland dominated by oaks of several species on arid slopes), low encinal and grassland, in each case away from the canyons and at considerable distances from water.

While these records are of some interest they fail to portray an adequate picture for two reasons: (1) the mode of travel in the area gives a bias toward canyon observations; (2) the number of observations is very small. Of greater value is the sum of observations of sign of coatis throughout the mountains. On that basis, plus the sight records, it may safely be said that coatis commonly use all of the chaparral, woodland and coniferous forest areas of the mountains. They apparently visit watering places frequently. They infrequently leave the woods to enter the open desert or grassland.

The fact that the species is well adapted to arboreal activity is consistent with its apparent habitat preference. Most of the foraging seems to be done on the ground, but they go up and down trees with nearly the rapidity of squirrels. The first line of escape is usually up a tree, but when cornered by man they commonly descend equally fast. It is at this juncture that injury and occasionally death may occur to harassing dogs.

Factual information on behavior is extremely meager. Social traits have been mentioned in the literature referring to Mexican, and Central and South American coatis (Allen, 1879; Burt, 1938; Davis, 1944; Tate, 1932). Litter size is based solely on scattered observations of young animals traveling with adults. The season of reproduction has been given (Davis, MS; Healy, 1952) but, again, the data are fragmentary and inconclusive.

Certain social habits of the species led earlier to the belief that there were two forms, the social type and the solitary type, which were taxonomically distinct. More perceiving observations by natives and naturalists revealed that certain older males, *solitarios*, were anti-social much of the time. However, other males have been seen and taken with groups.

Wallmo's notes relate the following experiences: "On June 9, 1950, I came upon a group in a small canyon in the oak woodland on the north end of the Huachucas. It was 11:15 AM of a very hot day. When I saw them I stopped in my tracks in the open sun. Ten animals were counted. The nearest (distances paced later) was 30 feet away, the farthest 75 feet away. The majority were half-grown animals wrestling on a log that had fallen across the arroyo. Three or four were always engaged in this game, the deposed often scrambling up the hill to forage under the rocks and litter, while others would bound down the slope and make a rush into the fight. The underbrush was so thick that those foraging on the hillside could not be identified. I was hatless and the hot sun soon forced me to creep toward shade, which movement broke up the game.

"On August 25, in upper Huachuca Canyon, I jumped a group in which I could count six animals. Two, which seemed somewhat smaller than the others, ran up a tree near me while the others ran off, except one large adult which climbed a tree some distance away and looked back toward me and the smaller chulas. The two near ones were collected.

"On September 28, 1950, at 10:15 AM, I had stopped to watch a pair of Huachuca grey squirrels in the bottom of Bear Canyon in a tall forest of oaks, sycamore and juniper. While I sat there a white-tailed deer fawn came into sight across the canyon and walked down to the stream 50 feet from me to drink. Shortly a spike buck appeared and walked toward the water until a noise upstream alerted him. A large female coati came down the stream making clucking noises. She was followed by six very small animals in single file, and lastly a large male. The moment the male appeared he bolted up the bank opposite, with no previous indication of alarm, and the rest followed. The fawn ran off at the same time but the spike buck stood still and watched the chulas scramble by within five feet of him on either side. Meanwhile the grey squirrels and seven band-tailed pigeons in the trees above remained completely unconcerned." It should be mentioned that the male was identified by his scrotal sac (and larger size) which was not apparent in the one called a female, even though she was considerably closer. Young and adults were all uniformly pale in color, though the young seemed somewhat darker than the adults. These facts of color will be referred to later.

The same morning two other groups were seen, one of 12 or more, including at least six very tiny young, the other group of one adult and five young (plus others unidentified). The larger group contained both dark (blackish) and pale (yellowish-brown) adults. The smaller group contained all pale animals. Within a distance of one mile along Bear Creek at least 26 separate individuals were seen that morning.

On September 22, Gallizioli saw a group of eight in Huachuca Canyon, of which two were obviously immatures. A group of 14 half-grown chulas was encountered in lower Garden Canyon in the afternoon of November 1, 1950. It is interesting to note that they were then in the range of an old solitary male, which we trapped that morning. This animal had been observed alone in that vicinity—near a stretch of running water in the usually dry streambed—on three previous occasions. On October 30 we set a box trap and found him in the trap the next morning. He was released after his tail was painted, in the hope of future recognition. He was very dark brownish-black in color, grizzled with white guard hairs, and with light grey or whitish shoulders. Another *solitario* seen twice below the mouth of Woodcutter Canyon was similarly colored and about the same size.

The color variation mentioned above is a fact of considerable interest, and one which has led to a great deal of ill-informed speculation involving sociality, taxonomy, and coloration. We have observed two rather distinct color types, one being uniformly pale cinnamon-brown to yellowish-brown, the other dark blackish-brown with dirty-white shoulders, chest and throat. Other markings, such as the black on the feet, white on the nose and white eye-spots, were alike in both.

A large adult male killed by T. St. John on December 4, 1950, was one of the dark type. It weighed 10 pounds, 10 ounces, and had a total length of 44 inches; tail length, 22.7 inches. The testes measured 0.9 inches; baculum, 3.13 inches.

A male and a female taken August 25, 1950 were of the pale type. They

measured 42 and 40 inches, respectively, with tail lengths of 21 and 20.5 inches. The male's testes measured 0.62 inches, the baculum 2.35 inches. The female contained no embryos or placental scars. By their actions they were thought to be immature, which observation for the male may be substantiated by the comparative baculum length.

Two juvenile males taken September 20, 1950, by H. W. Anderson, were considerably darker than the above pair but not distinctly of the "black" type. They measured 27.6 and 25.4 inches in total length; 14.2 and 12.8 inches in tail length; testes, 0.55 and 0.45 inches, respectively. The baculum of the smaller animal was 1.3 inches; that of the larger was not kept.

The observation of September 28, 1950 (above) in which "blacks" and "cinnamons" were seen together indicates that there may be neither a social nor a taxonomic difference between these forms, but that probably it is merely color variation. The clearly observed family of eight, in which both adults and all the young were "cinnamons", indicates that the color difference is not constantly a sex variation.

It has been suggested (Healy, *op cit.*) that the old solitaries are "cinnamons" but our experience of observing a *solitario* over a period of seven months and eventually trapping him indicates that that is not always true.

Arizona and New Mexico coatis have frequently been assigned to the geographic race *Nasua narica pallida* Allen. The subspecies *pallida* was described on the basis of five skins from southeastern Chihuahua (Allen, 1904), with the principal difference being a more pallid coat. However, Allen (*op. cit.*) earlier stated that, "Few of the terrestrial *Ferae* present a greater range of color-variation, wholly independent of sex and age, than do the species of Coati. Neither does the history of many groups afford so remarkable a record of malidentifications and consequent confusion and complication of synonymy." At that writing the nomenclature was clarified to species, *N. narica* (Linne) being the only accepted species north of the Isthmus of Panama, and *N. rufa* Demarest the South American species. Hershkovitz (1951) regards our form as *Nasua narica molaris* Merriam and considers the subspecies *pallida* and *tamaulipensis* as synonyms of *molaris*.

The information on food habits of coatis in Arizona is as scanty as is the taxonomic material. Their pilfering of fruit and poultry, resulting in the complaints mentioned earlier, has placed a heavy emphasis on that phase of their diet. In observations of chulas feeding in the wild during all months of the year except January, March and July, we saw them only foraging on the ground by snuffling through the leaves, turning rocks and logs, and digging with their powerful front feet. However, Mrs. Healy reported seeing them rob a robin's nest and Mr. Clint Post says he has seen them tearing up grey squirrel nests (personal conversations).

Stomachs collected from the five animals described above revealed, on superficial examination, only fruits of manzanita, juniper and prickly pear, insect remains (mainly beetles), and a few trace items. The droppings of the *solitario* trapped on November 1, 1950, consisted entirely of juniper berries. A female

trapped October 19, 1950, left droppings containing only manzanita berries. The difficulty of distinguishing positively between scats of coatis and grey foxes made it necessary to dispose of collections started.

In the spring of 1950, Mr. Earl Long (trapper with the U. S. Fish and Wildlife Service) found a deer fawn carcass that had been partly eaten by a number of coatis but he was unable to determine whether or not they encountered it as carrion.

The evidence is conclusive that coatis are decidedly omnivorous. That they enjoy peaches and apples taken from the tree, and that some kill poultry is undeniable. But their status as predators on animals of higher economic, sporting, or aesthetic value to man cannot be decided until a thorough study of food habits and populations is made.

SUMMARY

Coatis in Arizona are common in the Huachuca, Patagonia and Tumacacori mountains and are frequently observed in the Santa Rita and Chiricahua mountains as well. The determination of population numbers is made difficult by their nomadic habits. Their gregariousness and tendency to scurry off in all directions when flushed by man has led to exaggerated estimates of numbers in individual bands. Two distinct color phases were noted, a pallid or cinnamon phase, and a darker, blackish-brown phase. Altitudinally, coatis range from chaparral, through woodland to the coniferous forest areas of the mountains. Older males, *solitarios*, are often anti-social much of the time. Immature animals in various stages of development were observed in the months of June, August, and September. Analysis of five stomachs revealed only fruits of manzanita, juniper and prickly pear, insect remains and trace items. Reports from local residents, however, indicate that on occasion they are not averse to robbing bird and squirrel nests, poultry yards, and fruit orchards. Though currently unprotected by law, there is little likelihood that traps and guns will endanger the species.

LITERATURE CITED

Allen, J. A. 1878. On the coatis (genus Nasua, Storr). Bul. U. S. Geol. and Geogr. Surv. of the Territories, 5: 153–174.

———. 1904. Mammals from southern Mexico and Central and South America. Bul. Amer. Mus. Nat. Hist., 20: 29–80.

Burt, W. H. 1938. Faunal relationships and geographic distribution of mammals in Sonora, Mexico. Misc. Publ. Mus. Zool., Univ. Michigan, 39: 1–77.

Cahalane, V. H. 1932. Mammals of the Chiricahua Mountains, Cochise Co., Arizona. Jour. Mamm., 20: 418–440.

Davis, W. B. 1944. Notes on Mexican mammals. Jour. Mamm., 25: 370–403.

———. Mammals of western United States (Manuscript).

Healy, I. H. 1952. The coati-mundi. Arizona Highways, 28: 31–33.

Hershkovitz, P. 1951. Mammals from British Honduras, Mexico, Jamaica and Haiti. Fieldiana: Zoology, 31: 547–569.

Taber, F. W. 1940. Range of the coati in the United States. Jour. Mamm., 21: 11–14.

Tate, G. H. 1931. Random observations on habits of South American mammals. Jour. Mamm., 12: 248–256.

Taylor, W. P. 1934. Coati added to the list of United States mammals. Jour. Mamm., 15: 317–318.

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FOOD HABITS AND NOTES ON LIFE HISTORY OF THE RING-TAILED CAT IN TEXAS

By Walter P. Taylor

In a country where upland game birds are important and fur animals abundant questions of predation inevitably arise. This is true in the Edwards Plateau, Texas. As one of the remaining wild turkey strongholds in the United States it is outstanding, recent estimates having indicated a population of some 65,000 to 73,000 wild turkeys in the region (Taylor, Blakey, Hahn and Walker, 1951, unpub. ms.).

Fur animals of the region include the gray fox (*Urocyon cinereoargenteus*), the Virginia opossum (*Didelphis marsupialis*), raccoon (*Procyon lotor*), prairie spotted skunk (*Spilogale interrupta*), broad striped skunk (*Mephitis mephitis*), mountain hog-nosed skunk (*Conepatus mesoleucus*), bobcat (*Lynx rufus*), and ring-tailed cat (*Bassariscus astutus*). The coyote (*Canis latrans*), the gray and the red wolf (*Canis lupus* and *Canis niger*) and the cougar (*Felis concolor*), formerly more or less abundant, have been eliminated from most of the area through control operations in the interest of domestic sheep, goats, and cattle.

In response to requests from the ranchmen of the Edwards Plateau, the Texas Game, Fish and Oyster Commission, in cooperation with the Texas Cooperative Wildlife Research Unit, undertook a study of the food habits of the fur animals of the Edwards Plateau with a view to determining their role in relation to wild turkeys and other game, as well as domestic livestock and poultry. Among those associated with the work have been J. D. Bankston, Phil D. Goodrum, W. C. Glazener, Daniel W. Lay, E. G. Marsh, R. R. Ramsey, Tarleton F. Smith, Walter P. Taylor, E. A. Walker, and a number of other field assistants, administrators, and trappers, as well as ranch owners and operators. Initial field work by the Wildlife Unit was done in the summer of 1937. This was followed by intensive yearlong activities beginning October 1, 1940, and continuing through 1943. Analyses and tabulations of material collected have continued at intervals up to this date (1952).

Analysis of the material was by specialists at the Patuxent Research Refuge, Fish and Wildlife Service, Laurel, Maryland, including R. T. Mitchell, W. H. Stickel, L. F. Stickel, J. H. Watts, R. E. Stewart, H. D. Fields and W. G. Swank, under the direction of Arnold Nelson. Tabulation of material was by Gertrude Ware Dubois, Alyne Clooney and Sybil Hahneman at the College Station office of the Wildlife Unit. Until his transfer to the leadership of the Oklahoma Unit at Stillwater, February 4, 1948, direct supervision of the field and office work was by Walter P. Taylor, as leader, Texas Cooperative Wildlife Research Unit. Then George A. Petrides became Texas Unit Leader.

Observational, trapping, and hunting activities resulted in the steady accumulation of material representative of the fur animals already mentioned, and a few others. Approximately 2,000 specimens of the various fur animals were taken, a larger number than heretofore collected for this purpose, so far as known, anywhere in the Southwest. First notice of the work was submitted in the Quarterly Report of the Texas Unit for January–February–March, 1942.

Of all the fur animals of the Edwards Plateau, probably the ring-tailed cat (*Bassariscus astutus*) is the least known. Furthermore, it is wide-spread and in places quite numerous. Like the gray fox, it is reported to be increasing in parts of Texas. In the fur market it has been highly popular at intervals, often, where it is abundant, accounting for a considerable proportion of trapper income. In 1943, ringtails brought more than $2.00 each to the Edwards Plateau trapper; in 1945, more than $10.00 each.

CHARACTERISTICS, HABITAT, AND DISTRIBUTION

Related to the raccoon, the ring-tailed cat is sufficiently removed therefrom to warrant reference to a separate subfamily, the Bassariscidae. For much pertinent information on the animal see Grinnell, Dixon, and Linsdale (1937: 166).

The ringtail occurred in almost every kind of habitat found in the Edwards Plateau. Rocky mesas and ridges, hills or slopes where cedars (*Juniperus* sp.) had been cut over, were much liked, especially when cedar berries were available. Cedar-shinnery tracts were favored. Even dense cedar was well-liked. The animals occurred on live oak savannahs, where they were trapped near water or park-like meadows, usually where hills and rocky breaks were not far away. They were found also in blackjack and post oak country, and at least one was taken on a blue thorn hill. Sometimes they occurred on mesquite flats not far from live oak and shin oak areas. Many were secured along rock washes, some with creeks flowing, most dry. The animals were often taken in brushy gulches, characterized by sycamores, Spanish oaks, live oaks, cedars, and redbuds. They were very much at home in trees; in the crevices and cracks of rocky bluffs and accumulated boulders. A common habit was to climb up on logs or rocks or tree limbs to defecate. Often ringtails patrolled the pasture boundary fences. They also utilized "game" passes from bluff-tops to nearby creek bottoms.

The ringtail's fondness for cedar (*Juniperus*) berries may account for its sometimes being more abundant than other fur animals in barren, overgrazed, cedar pastures. Thus in March, 1943, on the depleted Brandon Ranch, trapper Bankston was able to catch only ringtails. In general there were relatively few fur animals on severely overgrazed ranges.

In the old days, settlers built rock fences to keep their pastures separate. These fences, now in more or less decadent condition, still stand, in places from one to three feet high. They make ideal denning or sheltering places for fur animals, including ringtails.

J. D. Bankston, a trapper of prowess and long experience in the Edwards Plateau, estimated the numbers of ringtails at ten per square mile in suitable broken country, such as, for example, the Divide country of Kerr County, Texas. We have no way of knowing how close this is to the actual facts, but as an estimate it is probably about as close as one can come at present. It is Bankston's opinion that the animals have been increasing the past few years, just as have the gray foxes. In California, the ringtail's population density in respect to its entire range is one individual to five square miles, although in certain favored localities there may be as many as six to each square mile (Grinnell, Dixon, and Linsdale, 1937: 182).

HABITS

Breeding.—In the Edwards Plateau country, ringtails are reported to breed later than other animals. Pregnant females were taken from April 16 to May 7, and young ringtails from the middle of May on, at least, until August, when very nearly full growth was attained. The young were three or four in number. It appears that the kittens stay with the mother, at least in some instances, well into August, and that weaning may not take place until that time. Clark (in Baird, 1859: 19) recorded a female found in the crevice of a rock (on Devil's River, Texas, near Eagle Pass) with four or five young adhering to the nipples. "To detach these required considerable force; previous to that time they showed no signs of discomfort although the mother had been dead several hours". This is the only record we have found of young clinging to the teats of the mother.

Food materials found about occupied dens, as though they were being fed to the young, included birds (bobwhite, cardinal, mourning dove) and mammals (fox squirrel, cottontail, white-footed mouse). Some August droppings showed the animals feeding on Mexican persimmons.

The young must survive many vicissitudes to grow up. One youngster had been swallowed and disgorged by a snake. Many young were reported by Bankston to die when they could not get to water in dry seasons. Grinnell, Dixon, and Linsdale (1937: 181) assert the ringtail will not live where there is no water.

Dens.—Denning by the ringtail was very informal. In the rocky Edwards Plateau region, it was in almost any convenient place, in cracks or crevices in the rocks or bluffs, in rock fences, under large boulders in the creek bottoms, in hollow blackjack logs or hollow trees, live oaks, cherry trees, etc. Sometimes the animal used a hollow some distance above the ground in a tree. Occasionally there was a bed of leaves or grass in the den, but often there was no nest material whatever. Sometimes the beds contained hair and a few bird feathers.

A large, fat male ringtail was taken in a hollow, blackjack log which had fallen in a liveoak-blackjack savannah association, not far from a rocky gulch. The log was about ten feet long and 14 to 18 inches in outside diameter. The hollow, inside, where the ringtail was denning, was but six to 12 inches in diameter. The opening in the base end of the log was six to eight inches in diameter. The log was plentifully provided with acorn hulls which had been stored and eaten, probably by rock squirrels. Bankston was of the opinion that each ringtail had several dens, and this is altogether likely.

Movements.—Bankston turned loose an adult ringtail in camp after dark. The animal loped away, humping along, tail straight out behind, drooping toward the end. It followed down the road for a short distance, then, seeing a post oak not far away, took to the tree, climbing up and pausing in a crotch, looking back. Its bright eyes were fiery red in the beam of a flashlight. In other lights the eyes paled to a whitish or yellowish-white eyeshine. The last we saw of the animal it was exploring the upper branches of the post oak, occasionally glancing back.

As a fur animal.—According to Bankston, skins of the ring-tailed cat stay in good condition until April 1. The furs are attractive, running to grays and yellows, with a face made conspicuous by a large circle of white around the bright eyes. The long bushy tail, however, is its greatest attraction. The striking coloration, eight black rings on a white background, is duplicated on no other animal, though doubtless indicating relationship with the raccoon. In the ringtail's climbing activities the tail must be of a good deal of importance as a balancing organ.

With its relatively limited distribution (southwestern and western United States), the ring-tailed cat is less well-known than the more broadly distributed fur animals such as the mink, fox, raccoon, and skunk. An amusing happening based on this was brought to our attention during the last year of World War II (1945). Those were the days of the Office of Price Administration, which, quite logically, had imposed a ceiling price on designated fur animals, including the raccoon, mink, and others, excepting the ring-tailed cat, of whose existence the OPA had apparently never heard. Thus it transpired that while relatively low prices were compulsory for the better-known and normally more expensive furs, the trappers were selling prime ring-tailed cat skins to buyers for $10.00 each, or, indeed, for anything they could get.

As a pet.—Its bright eyes, handsome coloration and graceful ways make the ringtail a handsome pet, although it is difficult to train it for life in the house. The early day miners in the Sierra Nevada of California are reported to have kept the animals commonly as pets (Nelson, 1930: 61).

A pet ringtail in the possession of the late Henry C. Hahn, Texas Game, Fish and Oyster Commission, Kerrville, Texas, was very greedy, consuming milk, insects, etc. It was gentle in its movements and enjoyed playing with the pointer dog. Especially at night it became very active. It liked to climb the window screens and was at home anywhere it could get a foothold. When turned loose, it did not run away.

A ringtail mother and four young were placed in a large cage June 5, 1943. Although she occupied the covered nest box we had provided, she seemed completely uninterested in the young. One was found dead on June 6, and a day later the mother ate one of the young. A third was quite weak and was found dead in the cage on June 9. The fourth young one lived for ten days more until killed by the mother. This parent had paid no obvious attention to the young, although on one occasion one of them was seen suckling.

The mother was fed jack rabbit, and later was given a variety of food, including commercial dog food, which she disliked, and banana and hamburger, both of which she ate greedily. She did not favor cooked sweet corn. On one occasion she ate a part of a ripe tomato. Defecation was on top of the nest box, sometimes on the plate on which food was served, often promiscuously about the big cage.

As a pet, this ringtail was hardly satisfactory as she did not show herself, remaining in her nest box during daylight hours.

The coughing bark of the ringtail, as heard in the cage, was only given when the animal was frightened or agitated. To my ear it was so much like the bark of a gray fox that in the open I am sure I would not distinguish it. Much time was spent seeking a way out of the cage. She even did some digging in the floor of the cage, though she never got down to the concealed wire beneath the dirt floor. As she worked over the inside of the cage, she gave a whimpering sound like the muffled crying of a small dog. One morning we discovered she had pushed the wire up enough from one part of the top of the cage to escape.

FOOD HABITS

According to Baird (1859: 19) an escaped captive "civit cat" near Washington, D. C. was killed in a hen-roost, ". . . after it had committed great devastation among the poultry of the neighborhood." Nelson (1930: 61), whose observation of the species was extensive, especially in Mexico, writes that the animal takes whatever edible comes its way. According to Grinnell, Dixon, and Linsdale (1937: 173, 179), in California ringtails are often found in greatest abundance in the same habitat with white-footed mice (*Peromyscus*) and wood rats (*Neotoma*) on which they largely live. The studies in Texas here reported afford additional information on food habits in that portion of the ringtail's range.

Analysis of contents of alimentary tracts.—In order to get the maximum of information from each specimen of fur animal taken in the present investigation not only stomachs, but also small intestines and large intestines (colons) were saved and separately analyzed. Aldous and Manweiler (1942: 252–255) showed that in the weasel (*Mustela erminea cicognani*) in Northern Minnesota, either stomach or intestinal contents gave a fair appraisal of the food. They pointed out also that if the stomach is empty and the intestine filled, the latter is usable in a food habits study. "In cases where both contain food, their contents represent two separate feeding periods and are therefore comparable to the contents of two stomachs or two intestines." The total contents of the entire alimentary tract, in this type of short-gutted carnivore with rapid digestion, is made up of remains of food eaten over a period of 12 to 48 hours prior to collection of the animal. Contents of the stomach, on the other hand, may have been in the stomach but a short time, at most for a few hours.

In the 256 individual ring-tailed cat specimens taken, analyzable materials were found in 175 stomachs, 171 small intestines and 224 colons, or a total of 570 alimentary "units" altogether. Obviously information on food habits is more complete as a result of examining the small intestines and colons in addition to the stomachs. It is understood that in the process of digestion diverse food materials remain in the stomachs for different periods of time, fats longest, proteins an intermediate period, carbohydrates shortest. Also, soluble materials will disappear from view as the food progresses along the alimentary tract. Various individual or seasonal feeding and defecating habits doubtless influence composition of the contents of the different parts of the digestive tract.

In the field, the stomachs, small intestines, and colons were separately wrapped in cheesecloth, labeled, and placed in formalin. After cataloging, the material was shipped for analysis to the Fish and Wildlife Service's Patuxent Research Refuge, Laurel, Maryland. The information was entered on cards and is the basis for the results given here (Table 1).

TABLE 1.—*Aggregate percentages of food in 256 specimens of ring-tailed cat throughout the year*

FOODS	FALL (40 INDIV.)	WINTER (80 INDIV.)	SPRING (79 INDIV.)	SUMMER (57 INDIV.)	YEARLONG TOTALS
Plants	24.72	17.47	16.85	16.08	18.05
Mammalia	15.47	36.13	32.28	4.98	24.22
Aves	11.97	24.28	6.86	3.84	11.72
Reptilia	.01	.37	2.30	1.68	1.28
Amphibia				.08	.02
Insecta	36.02	20.10	31.11	56.80	34.97
Arachnoidea	8.37	1.59	5.83	12.82	6.72
Undetermined arthropod		.05			.01
Chilopoda	3.43	.01	4.77	3.72	3.01
Diplopoda	.01	Tr.	Tr.		Tr.
Total	100.00	100.00	100.00	100.00	100.00

Results of analyses by seasons.—In the autumn, insects made up more than a third of the ringtail's food (36 aggregate per cent), with plants next (25 per cent) and mammals third (15.5 per cent). Birds were an appreciable item totalling 12 per cent of the food in the fall. Spiders (more than 5 kinds) aggregated more than 8 per cent of the fall food, and centipedes over 3 per cent.

The principal insects consumed, by approximate aggregate percentages, were Orthoptera, 25 per cent (*Gryllus assimilis*, 14: *Ceuthophilus* sp., 4; Acrididae, 3.5; and others in lesser amounts); Lepidoptera, 7.5; Coleoptera, more than 6 kinds, 1.6; Hemiptera, 5 kinds, 0.7; Hymenoptera, 0.6; Diptera and Odonata, trace each.

One-fourth of the ringtail's fall food was plants. Amounts taken, by aggregate percentages, included *Diospyros texana*, 7; *Juniperus* sp., 5; *Celtis* sp., 5; *Quercus* sp., 3; *Condalia spathulata*, 2; *Rhamnus caroliniana*, *Physalis* sp., *Vitis* sp., *Opuntia* sp. and undetermined material, 1 or less each.

The aggregate percentage of mammals ingested was 15.5, with items as follows: Leporidae, 3.4; *Sigmodon hispidus*, 3.4; undetermined juvenile mammal, 3.4; *Sciurus niger*, 3.3; *Mephitis* sp., 1; *Peromyscus* sp., 0.8.

The aggregate percentage of birds was 12, itemized as follows: *Cyanocitta cristata*, 6.7; *Pipilo* sp., 3.4; passerine, 1.7; undetermined bird, 1.

In winter, mammals and birds formed a considerably larger proportion of the ringtail's food than in the fall, mammals 36 per cent (largest food aggregation for the season), birds 24 per cent. Even at this coldest season of the year insects made up one-fifth of the food, 20 per cent. Plants were a little more than 17 per cent of the winter food. Spider-like animals decreased to between 1 and 2 per cent, and other items were scattered. Some of the details follow.

Considering the mammals first, Leporidae (unidentified), made up an aggregate percentage of about 9, and in addition, *Sylvilagus* sp., nearly 8. Unidentified Cricetinae totalled more than 6, with identified items as follows: *Neotoma* sp. nearly 4; *Sigmodon hispidus*, 2; *Reithrodontomys* sp. and *Peromyscus* sp., less than 1 each. The Sciuridae were represented by *Sciurus niger*, 2.3, and *Citellus variegatus buckleyi*, 1.2. *Odocoileus virginianus* totalled 1.2, *Mephitis* sp., 5, and *Perognathus* sp., less than 1. There was a trace of domestic cow, doubtless, along with some of the other items, derived from carrion.

Among the birds the unidentified Passeriformes made up an aggregate percentage of nearly 9, followed by *Richmondena cardinalis* with nearly 6, *Turdus migratorius* with about 2, and an undetermined bird, 1.2. Less than 1 each of the following was found: Columbidae, *Zonotrichia albicollis*, *Centurus aurifrons*, *Pipilo maculatus*, *Toxostoma* sp., *Colaptes auratus*, *Aphelocoma* sp., *Dryobates scalaris*, and *Cyanocitta cristata*.

The Insecta totaled an aggregate percentage of 20, with items as follows: Orthoptera,

about 16 kinds, 9; Lepidoptera, probably 2 kinds, 8. Less than 1 each: Hymenoptera (5 kinds); Hemiptera (5 kinds); Coleoptera (8 kinds); Odonata (3 kinds). There was also 1 per cent of undetermined insect material.

An aggregate percentage of about 17.4 of the ringtail's winter food was plants, including *Celtis* sp., 7.2; *Phoradendron* sp., 7.1; *Sophora affinis*, 2; *Opuntia* sp., *Sapindus drummondi*, and undetermined plant tissue, less than 1 each.

The Arachnoidea totalled 1.5 aggregate per cent, and Reptilia, Chilopoda, and Diplopoda altogether made up less than 1.

With spring came a substantial increase in the consumption of insects, which made up nearly one-third of the diet. Mammals, as food, still held top place, showing a small decline from the aggregate percentage of 36 in winter to 32 in spring. Birds dropped off noticeably. Perhaps other foods were easier to secure or birds became more alert or less abundant. Plants held on about the same as in winter. The spider-like animals furnished nearly 6 aggregate per cent of the spring food, while centipedes totalled nearly 5 and reptiles a little over 2.

Twelve kinds of mammals were identified or segregated, as follows: Leporidae, aggregate percentage, 11.3; *Peromyscus* sp., 4.3; *Sciurus niger*, 4.1; *Sylvilagus* sp., 3.8; undetermined mammal material, 3.5; the following each in an amount of 1 per cent or less: Chiroptera, Cricetinae, *Citellus* sp., *Odocoileus virginianus*, *Perognathus hispidus*, *Neotoma* sp., and *Ovis aries*. The latter item, and doubtless some of the others, were obviously from carrion.

Aggregate percentages for the insects were as follows: Orthoptera, 12 kinds, 9.6; Lepidoptera, 7 kinds, 9.5; Coleoptera, 17 kinds, 9; Hemiptera, 5 kinds, 1.5; Hymenoptera, 7 kinds, 1.4; Diptera, trace, for a total for the insects of 31 per cent.

Plant materials in spring totalled an aggregate percentage of 17, with *Juniperus* sp. leading off with 7.6, followed by *Celtis* sp. with a little over 4, *Berberis* sp. with just under 4, and *Sapindus drummondi*, *Sophora affinis*, *Melia azedarach*, *Morus* sp. and an undetermined fruit skin, less than 1 each.

Among the birds, which made up just short of 7 aggregate per cent, were *Passerina cyanea*, 1.5; *Dendroica* sp., 1.5; *Colaptes auratus*, 1.2; *Zenaidura macroura*, 1.2; and the following with less than one each: unidentified passerine, *Colinus virginianus*, *Melospiza melodia*, *Tozostoma* sp., and undetermined bird—the last two, a trace each.

The Arachnoidea totaled an aggregate percentage of nearly 6, with 7 items represented, while the Chilopoda in spring had an aggregate percentage of about 4.7. Diplopoda were represented by a trace only.

In spring, reptiles figured more strongly in the diet than in either fall or winter, making up an aggregate percentage of 2.3. There were 12 separable items, none of which exceeded 1 per cent: Iguanidae, Scincidae, *Agkistrodon*, sp., *Opheodrys aestivus*, *Tantilla* sp., *Eumeces* sp., *Thamnophis* sp., *Leptotyphlops* sp., *Diadophis* sp., *Holbrookia* sp., *Cnemidophorus sexlineatus*, and *Sceloporus* sp.

As might be expected, insects comprised well over half (57 aggregate per cent) of the food consumed by the ring-tailed cat in summer. Mammals dropped to about one-twentieth of the diet (5 per cent), plants held about as in spring with 16 per cent, birds declined to less than 4 per cent. Spider-like animals made up the third largest major item of food consumed in summer (13 per cent). Centipedes with just short of 4 per cent, reptiles with less than 2 per cent, and amphibia with a trace, completed the total.

Here are some of the details. Of the aggregate percentage of 57 for the insects the Orthoptera accounted for 43 per cent, or more than three-fourths (Tettigoniidae, 23.4 per cent; Acrididae, 5 per cent; *Ceuthophilus* sp., 4 per cent; Gryllidae, 2.4 per cent; Blattidae, Cyrtacanthacrinae, and Conocephalinae, 2 per cent each, and 6 other families or subfamilies less than 1 per cent each).

Plants, which showed an aggregate percentage of 16, included *Diospyros texana*, 10.5; undetermined species, 1.5; Leguminoseae and *Prunus* sp., 1 each. In amounts less than 1 per cent each were: *Cornus* sp., *Echinocereus* sp., *Croton monanthogynous*, *Sophora* sp., *Celtis* sp. (trace), *Phytolacca* sp., *Viburnum rufidulum*, Graminae, vegetable debris, *Juniperus pinchotti*, *Opuntia* sp., and *Forestiera* sp. (trace).

The Arachnoidea showed a summer aggregate percentage of 13. This total was made up as follows: Scorpionida, 6.4 per cent; *Centauroides* sp., 3.4 per cent; Araneida, 3; and Solpugida, trace.

The mammals in the summer diet included *Odocoileus virginianus* hair, 2.1 per cent; *Lasiurus borealis*, 1.3; and Leporidae and *Sylvilagus* sp., less than 1 per cent each.

Birds, with just under 4 aggregate per cent, were *Dryobates scalaris*, 1.7; and each of the following with less than 1 per cent: passerine feathers, *Zenaidura macroura*, bird's egg, and *Colinus virginianus*.

Amphibia were present as just a trace, while Reptilia made up an aggregate percentage of not quite 2. Reptilian items included *Leptotyphlops dulcis*, *Tantilla* sp., Iguanidae, *Gerrhonotus liocephalus*, *Sceloporus* sp., and *Lacertilia eumeces*.

DISCUSSION

Principal plants eaten by the ringtail were cedar (*Juniperus*), hackberries, Mexican persimmon, mistletoe, spectacle berry, and barberry, with smaller amounts of cascara, Condalia, acorns, cactus (seeds and fruit fragments), soapberry, wild plums, unidentified legumes, and dogwood. Most of these are well-known staples of the fur animal fraternity. As usual, during open times of year when available, the luscious Mexican persimmons were more used than any other plant—in fact, when they were common, almost to the exclusion of any other plant. Cedar (*Juniperus*) berries totaled unexpectedly large. As Trapper Bankston said, based on observations of ringtails in March, 1942, "These varmints seem to be very fat on cedar berries." Hackberries and barberries were obviously well-liked, or at least much eaten. In winter mistletoe berries and hackberries were favored. In March, 1943, numerous soft piles of ringtail cat feces, largely made up of mistletoe berries, were observed on logs, prominent rocks, and at the tops of rock cliffs. During the winter when food for fur animals was not abundant, hackberries assumed great importance. The droppings of ringtails, skunks, raccoons and gray foxes were full of them. Experienced trappers often concentrate their efforts in the neighborhood of productive hackberry trees. In the fall, when available, appreciable use is made of acorns.

Among mammals, cottontails, fox squirrels, ground squirrels, white-footed mice, cotton rats, pocket mice, wood rats, harvest mice, deer (doubtless carrion), bats, domestic sheep (carrion), and skunks (carrion) were utilized. Rabbits and the white-footed mouse group loomed large in the diet.

Ringtails are frequently criticized for their consumption of birds. Among species taken were the bluejay, Texas jay, towhee, white-throated sparrow, cardinal, mourning dove, golden-fronted woodpecker, yellow-shafted flicker, Harris woodpecker, thrasher, robin, bobwhite quail, indigo bunting, song sparrow, and warbler (species unknown). But even in winter, when other foods were short, birds made up not more than one-fourth of the menu of the ringtail.

It is a mystery how the ringtail catches some of its prey. Perhaps the reptiles are hibernating or numb with cold when the ringtail gets them. Among those recorded were fence lizards, earless lizards, skink, garter snake, black-headed snake, worm snake, ring-necked snake, green snake, race runners, and even a rattlesnake.

Amphibia figured very little in the ringtail's diet, being represented by the humerus of a frog and fragments of a toad found in summer specimens.

The ringtail frequently takes many invertebrates. Small numbers of millipedes and more of centipedes were taken. Of spiders it captured a considerable quantity. Remains of these and of scorpions, daddy longlegs, vinegarones, and ticks were found in the alimentary tract. Like the insects, these cold-blooded forms were taken mostly in spring, summer and fall, dropping off to almost none during the winter months.

The ringtail feeds on a variety of insects. It will be remembered that these furnished about one-third of all the animal's food in spring and fall and well over half in summer. Among the orders of insects taken were grasshoppers, moths and butterflies, beetles, bugs, ants, bees, flies, dragonflies, and lace-wings.

SUMMARY

The ring-tailed cat is a denizen of rocky, brushy country throughout the Edwards Plateau region of Texas. In the most favorable parts of this area its numbers may approximate 10 to the section (640 acres).

The earliest pregnancy in this region was recorded April 16, the latest May 7, indicating a relatively concentrated breeding period. The young number two to four. The earliest young were born May 13. By August 10, the young were nearly full-grown.

In this region ringtails den in cracks or crevices in rocks, in hollow logs, or hollow trees.

Skins of the ringtail retain their primeness until about April 1, considerably longer than the raccoon or skunk.

The ringtail has been used as a pet since the gold-rush days of California.

A wide range of food is eaten, both plant and animal in character. The contents of the entire alimentary tracts (including stomach, small intestine, and colon) of 256 ringtails were analyzed to obtain information on foods eaten in this area.

In the fall insects made up the largest single item of food, with plant material next, and mammals and birds following in that order.

Mammals were the leading food item in winter, with birds next, insects third, and plant material fourth in amount.

Mammals continued to furnish the largest percentage of food in spring, insects next, and birds and spiders following in that order.

As might be expected, insects really dominated the food consumption in summer, with plants second, spiders third, and mammals and birds following.

Although there is some complaint regarding occasional ringtail depredations on poultry, and the animal does take an occasional bobwhite quail or mourning dove (one each in 256 specimens of ringtail collected), the seemingly beneficial food habits of the animal more than make up for any damage done.

LITERATURE CITED

Aldous, S. E. and J. Manweiler. 1942. The winter food habits of the short-tailed weasel in northern Minnesota. Jour. Mamm., 23: 250–255.

Baird, S. F. 1859. Mammals of the boundary. Zoology of the boundary, Part II, U. S. and Mexican Boundary Survey (Emory). 62 p.

GRINNELL, J., J. S. DIXON AND J. M. LINSDALE. 1937. Fur-bearing mammals of California. Berkeley, Univ. California Press, 1: 166–183.

NELSON, E. W. 1930. Wild animals of North America. Washington, D. C., Nat. Geog. Soc. 254 p.

TAYLOR, W. P., H. L. BLAKEY, H. C. HAHN, AND E. A. WALKER. 1951. The Rio Grande wild turkey in the Edwards Plateau of Texas. Federal Aid to Wildlife Restoration, Texas Game, Fish and Oyster Comm., Austin. (Unpub. ms.)

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MAMMALS OF THE MEXICAN STATE OF MORELOS

BY W. B. DAVIS AND R. J. RUSSELL

In conjunction with a survey of the wildlife resources of Morelos, considerable attention was given to a study of the kinds of mammals occurring in the state, their present distribution and abundance. In all 575 specimens of 67 kinds were collected by parties from the Department of Wildlife Management, Agricultural and Mechanical College of Texas. These constitute the main basis for the following report. Additional specimens in the Biological Surveys Collections were examined in the course of the study, permission for which was granted by Mr. Stanley P. Young of the U. S. Fish and Wildlife Service. Dr. Emmet T. Hooper, University of Michigan Museum of Zoology, gave helpful suggestions in the identification of specimens of *Peromyscus boylei* and *Reithrodontomys fulvescens*.

FAUNAL RELATIONSHIPS

The mammalian fauna of Morelos appears to have been derived from three sources or major centers of differentiation. These natural regions are the Nearctic, the Sonoran, and the Neotropical. Their faunas are named respectively: the boreal fauna, the Sonoran fauna, and the tropical fauna (Hooper, 1949), and each has its characteristic species, genera, and families.

The boreal fauna occupies most of the North American continent, including the western mountains and the Pacific coast. A number of forms also occur in the higher mountains of Mexico. The boreal fauna is represented in Morelos by a number of species, particularly in the highlands. The genera in Morelos that are considered boreal are *Sorex*, *Myotis*, *Eptesicus*, *Urocyon*, *Conepatus*, *Spilogale*, *Felis*, *Mephitis*, *Sciurus*, *Citellus*, *Lepus*, *Sylvilagus*, and *Odocoileus* (Burt, 1949). Many of these are wide-ranging mammals with broad ecological tolerances.

The Sonoran fauna occurs primarily on the arid plateaus, basins, and mountains of Mexico and the western United States. Two families, Geomyidae and Heteromyidae, and a number of genera have undergone their differentiation in the Sonoran region. The affinities of the Sonoran fauna are closer to the tropical fauna than to the northern boreal fauna; however, the Sonoran fauna is distinct from both. The following genera that occur in Morelos are here considered Sonoran in their affinities: *Bassariscus*, *Thomomys*, *Cratogeomys*, *Liomys*, *Perognathus*, *Reithrodontomys*, *Peromyscus*, *Baiomys*, *Neotoma*, *Neotomodon*, *Oryzomys*, *Sigmodon*, and *Romerolagus*.

The tropical fauna occurs in South America, Central America, and southern Mexico; it also extends northward along the eastern and western coasts of Mexico The lowland associations, the Arid Tropical Scrub and Tropical Deciduous Forest (Leopold, 1950), are mostly inhabited by species of this fauna. The tropical genera occurring in Morelos are *Didelphis*, *Balantiopteryx*, *Chilonycteris*, *Pteronotus*, *Mormoops*, *Micronycteris*, *Macrotus*, *Glossophaga*, *Choeronycteris*, *Leptonycteris*, *Artibeus*, *Desmodus*, *Eumops*, *Tadarida*, *Molossus*, *Nasua*, and *Dasypus*.

There are two sharply contrasting physiographic regions in Morelos, each supporting a characteristic flora and mammalian fauna. One is the arid lowlands, a part of the Balsas Basin, and the other is the humid highlands, a part of the Transverse Volcanic Mountain system. The lowlands include more than three-fourths of the land area in the southern part of the state, and the vegetation is of tropical affinities. The highlands are limited to the northern border of Morelos, and are formed by the Sierra de Ajusco and the volcano of Popocatepetl. The vegetation of the highlands is of temperate affinities. The division between the lowlands and the highlands lies approximately along the 6,500 foot contour.

The Lowland Associations. There are 45 native mammalian species and subspecies occurring in the lowland associations, 29 of which are restricted to it in Morelos. Bats of the family Phyllostomidae are all restricted to the lowlands with the exception of *Artibeus aztecus*. Other restricted kinds are *Desmodus rotundus*, *Molossus nigricans*, *Oryzomys couesi aztecus*, *Peromyscus melanophrys melanophrys*, *Baiomys musculus pallidus*, *Sigmodon hispidus obvelatus*, and *Neotoma alleni elattura*. Of the total kinds, 24 species have tropical affinities, comprising 53.3 per cent of the total. Nineteen of these tropical species are bats, two are rodents, and one is a marsupial.

The boreal fauna is represented in the lowlands by nine species, mostly mammals with wide geographic ranges in northern North America. Boreal species comprise 20.0 per cent of the total kinds. Only one species, *Lepus callotis*, is restricted to the lowlands. Other examples are *Myotis velifer velifer*, *Eptesicus fuscus miradorensis*, *Urocyon cinereoargenteus colimensis*, *Mephitis macroura macroura*, and *Odocoileus virginianus*.

Twelve species of close affinity to the Sonoran fauna occur in the lowlands, comprising 26.7 per cent of the total kinds. Some typical examples of Sonoran species are *Liomys irroratus*, *Perognathus flavus mexicanus*, *Reithrodontomys fulvescens mustelinus*, and *Baiomys musculus pallidus*. The small number of Sonoran species in the lowland associations is indicative of a lower degree of relationship with the Sonoran fauna than is characteristic of the highlands of Morelos and regions north of the volcanic mountain range, such as the Valley of Mexico, the northern section of Michoacan, and the northern parts of Puebla.

Four typical Sonoran genera, *Thomomys*, *Cratogeomys*, *Dipodomys*, and *Onychomys*, are not present in the lowlands of Morelos, and such genera as *Myotis*, *Citellus*, *Perognathus*, that are widespread in the Sonoran region, are represented by only one species each. *Peromyscus*, which is represented by a number of species on the Central Plateau of Mexico, is represented only by three species in the lowlands of Morelos, and only one species, *Peromyscus melanophrys melanophrys*

is restricted to the lowlands. Rodents comprise only 26.7 per cent of the lowland mammalian fauna with 12 species present, nine Sonoran, two tropical, and one boreal. Bats, on the other hand, make up 46.9 per cent of the fauna with 21 kinds. This low percentage of rodents and high percentage of bats in the Morelos lowlands is rather unique when compared with the mammalian fauna of other regions in North America.

In summary, the lowlands of Morelos (the Balsas Basin) is a distinct faunal area, and there is little relationship between it and the Central Plateau of Mexico or with regions to the south. In the lowlands of Morelos a number of tropical species, primarily bats, reach the northern limits of their range in Central Mexico, and a large number of species characteristic of the Central Plateau are absent. It is also interesting to note that there are no genera or species endemic to the Balsas Basin (using the lowlands of Morelos as a sample area); however, several subspecies are seemingly endemic, or nearly so, such as, *Oryzomys cousei aztecus*, *Baiomys musculus pallidus*, *Sigmodon hispidus obvelatus*, *Neotoma alleni elattura*, and *Dasypus novemcinctus mexicanus*.

The Highland Associations. There are 35 species and subspecies occurring in the mountainous sections of Morelos, which includes the Mixed Forest (oak-pine) and Boreal Forest (pine-fir-sacaton grass) Associations. Seventeen kinds are restricted to the highlands, for example, *Sorex saussurei*, *Sciurus nelsoni*, *Thomomys umbrinus*, *Reithrodontomys megalotus saturatus*, *R. chrysopsis chrysopsis*, *Sigmodon alticola amoles*, and *Neotomodon alstoni alstoni*.

The Sonoran fauna is well represented in the highlands by 16 species and subspecies, comprising 45.7 per cent of the total kinds. Thirteen of the Sonoran species are rodents, only four of which occur in the lowlands. None of the Sonoran forms is bats; one is a carnivore (*Bassariscus astutus astutus*). Other examples characteristic of the Sonoran fauna are *Thomomys umbrinus*, *Crategeomys merriami merriami*, *Peromyscus melanotis*, *Peromyscus difficilis felipensis*, *Neotomodon alstoni alstoni*, and *Romerolagus diazi*. The highlands exhibit a closer relationship with the Sonoran fauna than with either the tropical or the boreal faunas.

There are 12 species with boreal affinities in the highlands, comprising 35.3 per cent. Three boreal genera, *Sorex*, *Sciurus*, and *Microtus*, occur in the humid highlands but are absent in the lowlands. Most of the boreal species are wide ranging forms (*Myotis velifer*, *Eptesicus fuscus*, *Urocyon cinereoargenteus*, and *Sylvilagus cunicularius*), and occur in both the highlands and the lowlands in Morelos.

The tropical fauna, as one would expect, is very poorly represented in thle highlands. We recorded only five species, comprising 14.3 per cent of the total kinds. Of the five, only one, *Sigmodon alticola amoles*, is restricted to the highlands in Morelos. Three other species, *Tadarida mexicana*, *Conepatus mesoleucus*, and *Dasypus novemcinctus*, are wide ranging forms, occurring in both the highlands and lowlands. *Artibeus aztecus* has been reported from Morelos only from the Mixed Forest Association in the highlands, but it will probably be found to occur also in the lowlands when its range is more completely known.

Rodents comprise 57.1 per cent of the total kinds in the highlands with 20

species and subspecies. Bats, however, are poorly represented, there being only four species present, comprising 11.4 per cent. This differs markedly from the condition in the lowlands where bats were abundant and rodents were rather poorly represented.

In summary, the highlands are almost entirely populated by Sonoran and boreal forms. The closest relationship is with the Sonoran fauna. The highlands represent the southern boundry of that region, although isolated areas to the southeast may also show close affinity with the Sonoran fauna. The highlands show only a slight relationship with the tropical fauna, although the latter is well represented, especially by bats, in the lowlands.

ACCOUNTS OF SPECIES

Didelphis marsupialis californica Bennet. Opossum.—The opossum inhabiting Morelos is referable to the subspecies *D. m. californica* on the basis of its relatively short tail (ratio of nasals to condylobasal length, 47). Compared with *D. m. tabascensis* from Veracruz, these specimens have an actually, and relatively, shorter tail and nasals, the latter less acute posteriorly. Hooper (1947) records a specimen from Cuernavaca as *D. m. tabacensis*. On the basis of our material we question the correctness of this identification. For a discussion of the use of the name *D. m. californica*, see Hershkovitz (1951).

Opossums are common along the streams of Morelos. One of our specimens is in the black color phase; the other two are grayish. A female, collected on August 16, had nine young about 20 days old in her pouch. Several young individuals, about one-third grown, were caught in August. This suggests at least two litters a year in this region. *Records of occurrence:* Specimens examined, 3, all from Alpuyeca. Additional record: Cuernavaca (Hooper, 1947).

Sorex vagrans orizabae Merriam. Vagrant shrew.—Compared with *Sorex saussurei*, which is associated with *S. vagrans* in the boreal forest, *S. vagrans* can be recognized by its lighter color and the condition of the unicuspid teeth. In *S. vagrans* the third unicuspid is smaller than the fourth; in *S. saussurei* the third unicuspid is equal to or larger than the fourth.

Our two specimens, an immature male and an adult female, were caught in the tall clumps of sacaton grass that form an understory in the pine forest. Because of their small size and the difficulty of catching them in snap traps, these shrews probably are more abundant than our collecting indicates. *Record of occurrence:* Specimens examined, 2, both from 5 km. N. Tres Cumbres.

Sorex saussurei saussurei Merriam. Saussure shrew.—One specimen was collected at the end of a log that was lying along the base of a high rocky cliff in the pine-fir forest community. The big-eared rock mouse, *Peromyscus difficilis*, was abundant at this locality, living among the rocks on the cliff. The other specimen was collected in a heavy stand of sacaton grass in the pine-bunch grass community. It was associated with the vagrant shrew (*Sorex vagrans*), dusky harvest mouse (*Reithrodontomys megalotis*), and the black-eared mouse (*Peromyscus melanotis*). Another specimen, reported by Jackson (1928), was collected in the Mixed Forest Association at 6,600 feet elevation. *Records of occurrence:* Specimens examined, 2, as follows: 2 mi. W Huitzilac, 1; 4 km. N Tres Cumbres, 1. Additional record: Tetela del Volcan (Jackson, 1928).

Balantiopteryx plicata plicata Peters. Sac-winged bat.—This is one of the most common bats in the arid lowlands of Morelos. It appears early in the evening, often before sundown. It can be recognized in flight by its small size and pipistrelle-like flight.

Martinez and Villa (1938) described as a distinct species, *Balantiopteryx ochoterenae*, specimens from Cuautla, Morelos. Unfortunately these specimens, including the type, were lost during Villa's absence from the Instituto de Biologia. The species *B. ochoterenae* was said to differ from *B. plicata* in paler color, the presence of long stiff hairs on the face

above the eyes and at the corners of the mouth, and in other minor details. These characteristics have been found to agree with specimens of *B. plicata* from Guerrero. Therefore, we regard *Balantiopteryx ochoteranae* a synonym of *Balantiopteryx plicata plicata* as have Burt and Hooper (1941) and Dalquest, Frum, and Hall (1950).

A female collected June 8, 1951, at Amacuzac had one embryo that weighed 2.2 grams and measured 26 mm. from crown to rump. Other adult females captured in the same cave were not pregnant. *Records of occurrence:* Specimens examined, 59, as follows: Alpuyeca, 23; Amacuzac, 3; 3 mi. SW Puente de Ixtla, 3; Tecuman, 18; Temilpa, 1; 12 km. N Axochiapan. Additional records: Cuernavaca (Sanborn, 1937); Cerro de Jojutla and Cuernavaca (Ward, 1904); Cuautla (Martinez and Villa, 1938).

Chilonycteris rubinginosa mexicana (Miller). Leaf-lipped bat.—Our two specimens were collected in a cave near Huajintlan, which they occupied with *Macrotus mexicanus* and *Leptonycteris nivalis*. Both of these specimens are in the brown color phase. These bats are probably confined to the arid lowlands of Morelos. *Record of occurrence:* Specimens examined, 2, both from Huajintlan. Additional record: "Morelos" (Rehn, 1904*b*).

Chilonycteris personata Wagner. Leaf-lipped bat.—Our three specimens constitute the first record for Morelos and from the interior plateau region of Mexico. A previous record from Veracruz (Dalquest and Hall, 1949) extended the known range of this species north from Guatemala. These bats are probably associated with the tropical vegetation occurring along the lowland streams that traverse the arid plateau. Ours were shot in flight a short distance from such a habitat.

These bats, like *Balantiopteryx*, emerge early in the evening and associate with that species in its evening flight. We were unable to distinguish the two species in the air.

All three specimens are bright fulvous above and below. A feature seemingly not mentioned in the literature is that the wing membranes attach high in the lumbar region producing a partial naked-back condition, but not carried to the extreme found in *Pteronotus*. *Record of occurrence:* Specimens examined, 3, from Alpuyeca.

Pteronotus davyi fulvus (Thomas). Naked-backed bat.—This bat is apparently rare in Morelos. Bats were collected extensively, but only one specimen of this species was taken. It was shot over a marshy area in the lowlands while in flight. Our specimen is in the brown color phase. *Record of occurrence:* Specimen examined, 1, from Temilpa.

Mormoops megalophylla senicula Rehn. Cinnamon bat.—We did not encounter this bat. It seemingly is a rare species in Morelos. *Record of occurrence:* "Morelos" (Rehn, 1902); Cerro de Jojutla, a locality 6 km. SE Jojutla (Ward, 1904).

Micronycteris megalotis mexicana Miller. Little big-eared bat.—Both Martinez and Villa (1938) and Ward (1904) record specimens from the lowlands. Seemingly these are the second and third records for Mexico, the first being from Plantimar, Jalisco, the type locality. *Record of occurrence:* Cuautla (Martinez and Villa, 1938); Cueva de Liona, District of Juarez (Ward, 1904).

Macrotus mexicanus mexicanus Saussure. Leafed-nosed bat.—Apparently this is the most common bat in the arid lowlands of Morelos. We encountered hundreds of them inhabiting the tombs of an old monastery near Puente de Ixtla, and in a cave near Huajintlan it was the predominant species. One individual was found hanging from the ceiling of an open porch at Alpuyeca. An effort was made to catch it as it flew back and forth, but it escaped into the open. This bat inhabits the abodes of man as does *Tadarida*. *Records of occurrence:* Specimens examined, 24, as follows: Hda. San Gabriel, 8; Puente de Ixtla, 10; Huajintlan, 6. Additional records: Cuautla (type locality) and Cuernavaca (Rehn, 1904*a*); Las Estacas (Martinez and Villa, 1938).

Glossophaga soricina leachi (Gray). Long-tongued bat.—Our specimens from western Morelos are typical of the subspecies *leachi*. The upper incisors protrude forward almost parallel to the postero-anterior plane of the skull, and appear crescentic in outline when viewed from above. The color is light brown. The significant differences between *G. s. leachi* and *G. s. alticola* are not in size but in the morphological character of the incisors and in color. The thumb averages shorter in our specimens of *leachi* from Morelos, with only one

individual, a male, reaching 7.0 mm. The thumb measurement of females is shorter than that of males. It should be noted, however, that Hall and Villa (1949) found the thumb to average 7.4 in specimens referred to *G. s. leachi* from Michoacan. Apparently the thumb varies in length from population to population.

We found large numbers of these bats in caves, one of which was not much more than a deep pocket in a hillside.

Martinez and Villa (1938) described *Glossophaga morenoi* from Xiutepec, Morelos. These specimens were later lost. The characters ascribed to *G. morenoi*, except for the absence of a tail, are applicable to specimens of *G. s. leachi*. All of our 43 specimens of *Glossophaga* from Morelos have a tail, although it is not apparent on some prepared skins. Because of this, we suspect that Martinez and Villa may have overlooked this structure on their specimens. Using the original description and our own collection as a basis, we feel assured in placing *Glossophaga morenoi* as a synonym of *Glossophaga soricina leachi*. *Records of occurrence:* Specimens examined, 30, as follows: Alpuyeca, 20; Puente de Ixtla, 1; Hda. San Gabriel, 2; Cañon del Lobo, 7. Additional records; Cuernavaca and 20 mi. S. Cuernavaca (Miller, 1913); Xoxicolco [probably = Ruinas de Xochicalco] (Ward, 1904); Xiutepec (Martinez and Villa, 1938).

Glossophaga soricina alticola Davis. Long-tongued bat.—The validity of this subspecies seems assured on the basis of our 20 specimens which agree so closely with the type and paratype from Tlaxcala that the recognition of the eastern race seems necessary. The race *G. s. alticola* is separated from *G. s. leachi* on morphological characters and darker color, rather than on size, although it is slightly larger than *G. s. leachi*. The upper incisors in *G. s. alticola* are much less projected forward and are in a normal position, that is, they are more nearly perpendicular to the postero-anterior plane of the skull (Davis, 1944). They do not exhibit a crescentic outline when viewed from above as in *G. s. leachi*. The color is dark sooty in contrast to the light brown of *G. s. leachi*. However, a few specimens of *G. s. leachi* from Alpuyeca match *G. s. alticola* in color.

These specimens of *G. s. alticola* were collected near the entrance to a large deep cave. One specimen of *Choeronycteris mexicana* was collected with them. *Records of occurrence:* Specimens examined, 20, as follows: 2 mi. S Jonacatepec, 13; Santa Clara, 7.

Choeronycteris mexicana Tschudi. Long-tongued bat.—These specimens represent the first records of this species from Morelos.

Near Axochiapan these bats were found hanging from the exposed roots of trees growing on the bank of a deep ravine. The foliage hung over the cut excluding sunlight and making a shady retreat. The one specimen collected at Jonacatepec was found hanging near the entrance of a large, deep cave. It flew when first disturbed, but immediately returned and was then shot. It shared these quarters with a large number of *Glossophaga s. alticola*. *Records of occurrence:* Specimens examined, 4, as follows: 12 km. N Axochiapan, 3; Jonacatepec, 1.

Leptonycteris nivalis nivalis (Saussure). Leaf-nosed bat.—Seemingly this constitutes the first record of this species from Morelos. On geographic grounds our specimen should be within the range of *L. n. verbabuenae* Martinez and Villa (1940), described from material a short distance from Yerba Buena, Guerrero. Because the type material was destroyed with the rest of Villa's collection, we follow Hall and Villa (1949) in tentatively assigning our specimen to the subspecies *L. n. nivalis* until topotypes of *L. n. verbabuenae* are available for comparison.

It is interesting to note that in our specimen the lower incisors are absent and there is no indication of alveoli. This has been attributed to accident. The specimen is tailless, the zygomatic arch is complete; there are two premolars and two molars above, and three premolars and two molars below. The wing is noticeably shorter than in representatives of *L. n. nivalis* from Texas, due to the shortening of the phalanges of the third finger.

This bat was taken in a cave where it occupied quarters with *Macrotus* and *Chilonycteris*. *Record of occurrence:* Specimen examined, 1, from Huajintlan.

Artibeus planirostris planirostris (Spix).—This appears to be a rare bat in Mexico, and this is the first record of its occurrence in the state. All of our specimens have the

minute third molar. It should also be noted that compared with *Artibeus jamaicensis* from Veracruz the second molar is separated by a conspicuous space from the first, whereas in *A. jamaicensis* the second molar fits closely against the first. Although Hershkovitz (1949) considers *A. planirostris* as a synonym of *A. jamaicensis*, we follow Anderson (1908) until the evidence is more conclusive.

All of our specimens were caught while they were hanging in their diurnal retreat under large banana leaves that were bent over to form a canopy. *Record of occurrence:* Specimens examined, 3, from Alpuyeca.

Artibeus hirsutus Andersen. Hairy fruit bat.—This is the first record of this seemingly rare bat from Morelos. Our specimens extend the known range eastward from the type locality at La Salada, Michoacan.

The minute third molar is present in all but one of our specimens, but this one has the alveolar pits. This species is readily separated from *A. planirostris* by the thickly haired unropatagium, smaller size, and the light grayish color.

A difference in habitat was noted between *hirsutus* and *planirostris* in our field studies. Where *A. planirostris* was associated with tropical vegetation along streams, *A. hirsutus* was found hanging in the dark recesses of an old church in the arid uplands, denoting a preference for caves.

One of our females was carrying a young male half her size. The uropatagium of the juvenile was hairy as in the adults. *Record of occurrence:* Specimens examined, 7, all from Santa Clara, near Jonacatepec.

Artibeus jamaicensis jamaicensis Leach. Fruit bat.—We failed to collect this species in Morelos. It evidently occurs in the arid lowlands. *Record of occurrence*: "Morelos" (Andersen, 1908); Amacuzac and Las Estecas (Martinez and Villa, 1938).

Artibeus toltecus toltecus (Saussure). Fruit bat.—We did not encounter this species; however, Ward (1904: 654) records specimens from a cave on Cerro Frio, Hda. San Gabriel, District of Tetecala (a locality a short distance south of La Fundición near the Morelos-Guerrero line). Ward refers these specimens to *Dermanura cinereum* (Gervais). *Dermanura* has been reduced to a subgenus of *Artibeus* (see Andersen, 1908), and *Artibeus cinereus* has since been restricted in range to South America. Specimens from Mexico and Central America formally assigned to *A. cinereus* have subsequently been referred to *Artibeus toltecus toltecus*. Since the Morelos specimens are not available for study, and in view of the more recent nomenclature, we are tentatively assigning them to *A. t. toltecus*. *Record of occurrence:* Cerro Frio (Ward, 1904).

Artibeus aztecus Andersen. Fruit bat.—This small species of *Artibeus* was described from material taken at Tetela del Volcan, Morelos, on the southern slope of Mt. Popocatepetl. We failed to find it.

Desmodus rotundus murinus Wagner. Vampire bat.—A small cave we visited near Alpuyeca in August was inhabited by a colony of adult females and half-grown young. We failed to find it in numerous other caves and grottos searched in western Morelos in 1949, but a large series was collected in caves the following year in the eastern part of the state. Ward (1904) found a pregnant female in late October. *Records of occurrence:* Specimens examined, 31, as follows: 5 mi. NE Alpuyeca, 5; Cañon del Lobo, 12; Tlacotepec, 12; 2 km. S Jonacatepec, 2. Additional record: near Zacoalpan Amilpas (Ward, 1904).

Myotis velifer velifer Allen. Cave bat.—This wide ranging species is the most common bat in the forested highlands of Morelos. It emerges at twilight and forages for insects over the small treeless valleys. It retreats during the day to the crevices among the volcanic rocks that are abundant on the hillsides surrounding the valley floors.

Although this species also occurs in the arid lowlands, it is not as common there as in the highlands. *Records of occurrence:* Specimens examined, 8, as follows: 2 mi. W Huitzilac, 6; 5 km. N Tres Cumbres, 1; Alpuyeca, 1. Additional records: Las Estacas (Martinez and Villa, 1938), "Morelos" (Miller and Allen, 1928); and Cuernavaca (Ward, 1904).

Eptesicus fuscus miradorensis (Allen). Big brown bat.—This bat is nearly as abundant as *Myotis velifer* in the coniferous forest of the highlands. It associates with *M. velifer* in its evening flight, but tends to feed more about the crowns of the trees.

Martinez and Villa (1938) record eight specimens of *Eptesicus propinquus* from Cuautla. Goodwin (1946: 333) gives the following measurements for *E. propinquus* from Costa Rica: forearm, 40–42 mm.; greatest length of skull, 15.8–16.0 mm. Martinez and Villa record the following measurements for their specimens: forearm, 50.0–53.5 mm.; greatest length of skull, 20.0–21.0 mm. These last measurements agree with those of *E. fuscus* and also with those of our own specimens from Morelos. For this reason we place the specimens recorded by Martinez and Villa from Cuautla under *E. f. miradorensis*. *Record of occurrence:* Specimens examined, 3, from 2 mi. W Huitzilac. Additional record: Cuautla, 8 (Martinez and Villa, 1938).

Eumops glaucinus (Wagner). Mastiff bat.—One specimen, now in the U. S. National Museum, was reported by Sanborn (1932) from an unknown locality in Morelos. We did not find it. It seemingly is a rare bat throughout its range.

Tadarida mexicana (Saussure). Mexican free-tailed bat.—In the pine-oak forest we captured one specimen that had its daytime retreat under a small boulder on an open hillside. This appears to be a unique roosting place for bats of this species. Another was collected in association with a large number of *Glossophaga s. alticola* in an old monastery at Santa Clara.

Martinez and Villa record one specimen of *Tadarida brasiliensis* from Cuautla, in the lowlands. Ward (1904) also refers 46 specimens from various localities in Morelos, and also specimens from Ixtapalapa and Tacubaya, Federal District, to *T. brasiliensis*. Recently, the type locality of *T. mexicana* has definitely been established as Amecameca, Mexico (see Benson, 1944). In two of our specimens from Jonacatepec in the lowlands the breadth at the second molar (7.0 and 6.9 mm.) approaches *T. brasiliensis*. We regard these specimens as *T. mexicana*, but the true relationship between *T. brasiliensis* and *T. mexicana* is not clear to us. *Records of occurrence:* Specimens examined, 7, as follows: 1½ mi. SE Huitzilac, 1; 5 km. N Tres Cumbres, 1; Jonacatepec, 4; Santa Clara, 1. Additional records: "Morelos" (Shamel, 1931); Cuautla (Martinez and Villa); "Morelos" (Ward, 1904).

Molossus nigricans Miller. Free-tailed bat.—Ward (1904) lists eight adult specimens, 5 males and 3 females, from Hda. Cocoyotla (a locality about 4 km. NW of Coatlan del Rio) under the species *Molossus rufus* E. Goeff. *M. rufus* has subsequently been restricted in range to South America (see Miller, 1913). Ward (*op. cit.*: 644) records the length of the forearm of the Morelos specimens as varying from 48 to 51 mm. with an average of 49.3. The forearm of the Morelos specimens is significantly longer than that of either *M. sinalae* (43 to 47.5) or *M. aztecus* (36 to 41). The type locality of the latter species is Amecameca, Mexico, a short distance north of the Morelos state line. However, the forearm measurements of *M. nigricans* are given by Miller (1913) in his monograph of *Molossus* as from 47 to 51 mm., a range of variation equal to that given by Ward for the Morelos specimens. In addition, Miller (1902) gives the following measurements for the type specimen of *M. nigricans*: tibia, 18.6, and hind foot, 12. An average of the eight Morelos specimens are tibia, 17.2, and hind foot 12.4. Ward took no cranial measurements.

For the reasons given above, and with consideration of the now restricted range of *M. rufus*, we are referring the Morelos specimens to *M. nigricans*.

Ward (*op. cit.*: 643) also took two very young specimens with the adults in early October. *Record of occurrence:* Hda. Cocoyotla (Ward, 1904).

Bassariscus astutus astutus (Lichtenstein). Ring-tailed cat.—Ring-tailed cats were common on the rocky bluffs and along the rock fences near Tepoztlan. We failed to find them at any other locality in Morelos, but they can be expected in rocky, tree covered situations.

Several large burrows were seen along the rock fences, at one of which a ring-tailed cat was caught. The others were trapped at the base of a rocky hill that rises nearly 1,000 feet above the surrounding country. *Record of occurrence:* Specimens examined, 3, all from 2 mi. SW Tepoztlan.

Nasua narica molaris Merriam. Coati.—Unfortunately our one specimen, a young fe-

male, was lost. It was brought back alive from Morelos with the intention of keeping it until it was grown. It escaped and was never found.

Goldman (1942) lists Morelos as within the geographic range of *N. n. molaris*, but he gives no definite locality record. *Record of occurrence:* Specimen examined, 1, from 12 km. NW Axochipan. Additional record: "Morelos" (Goldman, 1942).

Procyon lotor hernandezi Wagler. Raccoon.—This species is wide ranging in Morelos. It seemingly reaches its maximum numbers in riparian situations although it also occurs in adjacent uplands. One was found dead beside the road near Tepoztlan. This was some distance from any sizeable stream. Along the stream near Alpuyeca, raccoons were numerous, judging from sign, and several steel traps were lost attempting to collect them. Our only specimen weighed 14.4 pounds. *Record of occurrence:* Specimen examined, 1, from Alpuyeca. Additional record: Tetela del Volcan (Goldman, 1950).

Mephitis macroura macroura Lichtenstein. Hooded skunk.—One of our specimens was collected in the Boreal Forest at an elevation of 10,200 feet. The humid conditions of this association are well pronounced. However, the hooded skunk reaches its highest population in the arid lowlands. One of our specimens is black-backed, the other two are white-backed. None showed evidence of breeding. *Records of occurrence:* Specimens examined, 3, as follows: 12 km. N Axochiapan, 1; Ruinas de Xochicalco, 1; 5 km. N Tres Cumbres, 1. Additional record: Cuernavaca (Howell, 1901).

Spilogale angustifrons angustifrons Howell. Spotted skunk.—We did not encounter this skunk although extensive collecting was done in the arid lowlands. It is apparently a rare species in Morelos, as there is only one previous record.

A mounted skunk of this genus was seen in a sporting goods store in Cuernavaca. Identification of the species was not certain, nor could we learn from the proprietor where it was caught. *Record of occurrence:* Yautepec (Howell, 1906).

Conepatus mesoleucus mesoleucus (Lichtenstein). Hog-nosed skunk.—Judging from their sign, these skunks were common in the Boreal Forest Association, where they seemingly are confined in the state. They are replaced at lower elevations by the hooded skunk, *Mephitis m. macroura*. *Record of occurrence:* Specimen examined, 1, from 2 mi. W Huitzilac.

Urocyon cinereoargenteus colimensis Goldman. Gray fox.— Foxes were the most abundant carnivores in Morelos. They probably reach their maximum numbers in the Tropical Deciduous Forest Association in the lowlands where most of our specimens were collected. They prefer the tree-covered hill sides. One specimen was collected in the Mixed Forest at the base of Mt. Popocatepetl, another was taken in the Boreal Forest at Huitzilac. However, foxes were not abundant in these last two associations.

A female caught in mid-June was lactating. Most animals were found to be eating fruits of various plants, but none of the stomach content could be identified. One animal had lost an eye, in which was found a shot gun pellet. The local inhabitants hunt these animals persistently. *Records of occurrence:* Specimens examined, 6, as follows: 2 mi. SW Michapa, 2; 5 mi. S Alpuyeca, 1; Ruinas de Xochicalco (3 mi. W Alpuyeca), 1; 5 mi. W Tepoztlan, 1; Tepoztlan, 1. Additional records: Cuernavaca, Tetela del Volcan, Huitzilac (Goldman, 1938).

Felis concolor azteca Merriam. Puma.—Pumas are not common in Morelos. They inhabit the inaccessible mountains in the northern sections of the state and the low rugged foot hills that rise from the arid lowlands. A male was shot by a local resident, July 29, 1950, north of Yautepec. External measurements in the flesh were obtained by Davis, but the skin and skull were not available as study specimens. Seemingly this is the first record of *F. concolor* from Morelos.

The puma of Morelos are tentatively assigned to *F. c. azteca* until more satisfactory material is available. This specimen was small (Total length, 1970 mm.; tail, 750 mm.; hind foot, 270 mm.) and additional specimens may reveal that the puma in Morelos is *F. c. mayensis*, a small race known to occur southeast of Morelos (Young and Goldman, 1946).

Citellus variegatus variegatus (Erxleben). Rock squirrel.—This is one of the southern-

most records for this species, the other being Tehuacan, Puebla (Davis, 1944). This species probably ranges through much of the upper Balsas Basin, but we did not find it in western Morelos. Ordinarily this species occurs in the arid lowlands, but Howell (1938) recorded one specimen from Morelos and Davis (1944) one from Rio Otlati, Puebla, both in the Mixed Forest Association.

Our specimens, captured in late summer, have brown, worn pelage on the rump. Four of our seven specimens, collected in August, are young of the year. An adult male weighed 737.2 grams; a female, 725.1 grams. The four juveniles averaged 393.2 grams.

Measurements of all our adults fall at the lower end of the range of individual variation for this subspecies as recorded by Howell (1938). *Records of occurrence:* Specimens examined, 7, as follows: 2 km. S Jonacatepec, 5; 12 km. NW Axochiapan, 2. Additional record: Tetela del Volcan (Howell, 1938).

Sciurus nelsoni nelsoni Merriam. Nelson's squirrel.—These squirrels seemingly are rare, and local residents confirm our own observations. Only one was collected, although an extensive survey was made of the forested section of Morelos. This animal was shot out of a nest high in a tall pine tree. Two others were seen in the forest west of Huitzilac, but could not be collected.

Our specimen has black head, feet, and legs. The upper parts are predominantly black with a wash of buff, especially along the sides. The underparts lack the bright reddish-brown color of *S. n. hirtus*, as known by specimens from the state of Mexico. *Record of occurrence:* Specimen examined, 1, from 5 km. N Tres Cumbres. Additional record: Huitzilac, (Nelson, 1899).

Sciurus nelsoni hirtus Nelson. Nelson's squirrel.—We did not encounter this subspecies in our field studies. Nelson (1899) remarks that *S. n. hirtus* is lighter in color than *S. n. nelsoni*, the under parts are bright reddish-brown, and the tail has a white instead of a buff wash.

The color differences in the two races of *S. nelsoni* were interpreted by Nelson as an indication of the readiness of these squirrels to vary with climatic conditions. Although they occupy the same associations only a short distance apart, the more humid environment of the mountains of western Morelos has produced the more melanistic race, *S. n. nelsoni*. *Record of occurrence:* Tetela del Volcan (Nelson, 1899).

Thomomys umbrinus peregrinus Merriam. Mexican pocket gopher.—The original description of this subspecies was based on a number of specimens that have since been separated into several races. Through the kindness of Mr. Stanley P. Young, topotypes of *T. u. peregrinus* from Salazar, Mexico, were made available for comparison. Specimens from Morelos are darker in color than the average topotype, only two from Salazar matching the dark color of our specimens; interparietals triangular instead of square; interorbital breadth wider (averaging 3.0 mm. wider in both males and females); rostrum broader (females 7.1 mm. as compared with 6.8 mm. and males 7.4 mm. as compared with 7.1 mm.). The greatest difference was found in the females where the hind foot was smaller (24.3 mm. as compared with 27.0 mm.) and the mastoid breadth wider (18.4 mm. as compared with 17.4 mm.). *Record of occurrence:* Specimens examined, 12, from 5 km. N Tres Cumbres.

Thomomys umbrinus vulcanius Nelson and Goldman. Mexican pocket gopher.—This subspecies was described from a single specimen collected on Mt. Popocatepetl, State of Mexico. It is apparently geographically isolated from *T. u. peregrinus* by the rather low pass to the west of Mt. Popocatepetl.

We have no record of this subspecies occurring in Morelos. But since the type locality is only a short distance from the Morelos state line and there are no visible geographic barriers to limit its range southward, it seems safe to assume that this race also occurs on Mt. Popocatepetl in Morelos.

Cratogeomys merriami merriami (Thomas). Merriam pocket gopher.—This large dark pocket gopher was common in the Mixed Forest south of Huitzilac, but rather difficult to trap. One of our specimens, a young female, is in the brown color phase, the others are black. The other two specimens are young adults, male and female, with weights of 406.7

and 527.5 grams, respectively. The tail of both of these is practically devoid of hair. The tail of the juvenile is well haired. *Record of occurrence:* Specimens examined, 3, from 1½ mi. S Huitzilac. Additional record: Huitzilac (Merriam, 1895).

Liomys irroratus minor Merriam. Spiny pocket mouse.—We follow Hooper (1948) in assigning the *Liomys* of the arid lowlands of Morelos to the subspecies *L. i. minor* because of their small size, short tail, and pale color. Our series of 46 specimens exhibits considerable cranial variation. The anteriorly expanded zygoma, the short, strongly tapered rostrum, and the posteriorly truncate nasals, supposedly characteristic of *L. i. minor*, were not constant in all specimens.

Specimens from eastern Morelos have longer skulls and longer nasals, indicating a cline toward larger size from west to east. When more material from western Puebla is available, it may be shown that *L. i. torridus* and *L. i. minor* are inseparable. Hooper (1948) also questioned the validity of *L. i. minor*.

Seemingly Morelos is an area of intergradation among several races of *Liomys irroratus*; namely, *torridus*, *pullus*, *acutus*, and "*minor*". Specimens from northeastern Morelos show definite intergradation with *L. i. pullus*, and are placed with that subspecies, although the series averages slightly smaller in size. A series from near Huitzilac in the Mixed Forest Association, elevation 8000 feet, is darker and slightly larger than animals from lower elevations. These may well represent intergrades of "*minor*" with *L. i. acutus*, but are most like "*minor*".

This species was the most common small mammal in Morelos. Males were found in breeding condition (enlarged testes) between July 7 and August 18. *Records of occurrence:* Specimens examined, 46, as follows: vicinity of Alpuyeca, 10; Huajintlan, 1; 2 mi. SW Michapa, 1; 1½ mi. SE Huitzilac, 8; Cañon del Lobo (6 mi. W Yautepec), 15; Temilpa, 4; 2 km. SW Jonacatepec, 1; 12 km. N Axochiapan, 3. Additional records: Cuernavaca, Puente de Ixtla, Yautepec (Goldman, 1911).

Liomys irroratus pullus Hooper. Spiny pocket mouse.—These specimens intergrade with *L. i. minor* of the arid lowlands. Although they are somewhat smaller than typical *pullus* from the Valley of Mexico, our specimens are larger than the largest individuals of *L. i. minor* in most respects. One adult male measures: total length, 251 mm.; length of tail, 140 mm.; length of hind foot, 31 mm., equaling those recorded for *L. i. pullus* by Hooper (1948). Our mice are dark in color and have long tails, matching *pullus* in these respects.

Spiny pocket mice were common along rock fences and in patches of grass and brush, where they were exceeded in numbers only by *Baiomys musculus*. One was caught at the entrance to a burrow, a small hole slightly over an inch in diameter. Males were in breeding condition in mid-June. *Records of occurrence:* Specimens examined, 6, as follows: 2 mi. SW Tepoztlan, 5; 10 mi. N Cuautla, 1.

Perognathus flavus mexicanus Merriam. Baird pocket mouse.—This small mammal is difficult to collect and probably is more abundant than our records indicate. These mice appear rather late at night. Two of our specimens were caught by hand after mid-night with the aid of a lantern; the other two were found in the daytime under rocks. Seemingly this species occurs only in grassy areas and abandoned fields on the lower mountain slopes.

Our specimens are referable to the subspecies *P. f. mexicanus*, as known to us by five specimens from Mexico, Hidalgo, and Puebla. They differ in shorter occipitonasal length (20.0 mm. as compared with 21.1 mm.); narrower mastoid breadth (11.6 mm. as compared with 12.2 mm.); and slightly shorter nasals (7.4 mm. as compared with 7.7 mm.). One specimen, from near Tepoztlan, has bright buffy, instead of white, underparts. These constitute the southernmost known records for the species. *Records of occurrence:* Specimens examined, 4, as follows: 10 mi. N Cuautla, 3; 5 mi. W Tepoztlan, 1.

Reithrodontomys megalotis saturatus Allen and Chapman. Western harvest mouse.—This was the most abundant species of harvest mouse and the most abundant mammal in the Boreal Forest with the exception of *Neotomodon*. This species prefers the dense clumps of sacaton grass, where it is associated with *Sorex vagrans*, *Reithrodontomys chrysopsis*, *Peromyscus melanotis*, and *Neotomodon alstoni*.

Our specimens, predominantly adults, are smaller than specimens from Las Vigas, Veracruz, the type locality (Howell, 1914). Comparable external measurements are: Total length, 157 mm. as compared with 162 mm.; length of tail, 81 mm. as compared with 87 mm.; hind foot, 18.0 mm. as compared with 19 mm. However, they agree with the few cranial measurements given by Howell. *Records of occurrence:* Specimens examined, 26, as follows: 2 mi. W Huitzilac, 4; 5 km. N Tres Cumbres, 22. Additional record: Huitzilac (Howell, 1914).

Reithrodontomys fulvescens mustelinus Howell. Fulvous harvest mouse.—On geographic grounds these specimens would seem referable to *R. f. toltecus*. However, they differ significantly from that race in smaller size (total length, 169 mm., as compared with 193 mm.); shorter hind foot (19 mm. as compared with 21.5 mm.); narrower brain case (8.0 mm. as compared with 9.1 mm.); shorter skull (21.6 mm. as compared with 23.4 mm.); shorter nasals (8.5 mm. as compared with 9.4 mm.); shorter molar tooth row (3.2 mm. as compared with 3.9 mm.). Our specimens have white underparts instead of the light pinkish cinnamon color characteristic of *R. f. toltecus*.

Dr. Emmet T. Hooper informs us that the harvest mice of this species occurring in the Balsas Basin (including Morelos) also differ from *R. f. helvolus*, which ranges to the south in Oaxaca and Puebla. He has examined a number of specimens from the Balsas drainage and has assigned them to *R. f. mustelinus*. Specimens of *R. f. mustelinus* from "typical" localities are not now available for comparison, but when adequate material is available, the harvest mice of this species occurring in the Balsas Basin may prove to be an undescribed subspecies.

Fulvous harvest mice were relatively uncommon in Morelos. All of our specimens are males that were caught among rocks. They appeared rather late at night, the first being caught after 11:00 P.M. *Records of occurrence:* Specimens examined, 4, as follows; 5 mi. W Tepoztlan, 3; 2 mi. SW Tepoztlan, 1.

Reithrodontomys sumichrasti sumichrasti de Saussure. Rufescent harvest mouse.—Our specimen is referred to *R. s. sumichrasti* because of its cinnamon colored underparts, light ears, long unicolored tail, and the absence of a complete subsidiary enamel loop on the upper molars.

This record constitutes a southwestward extension in the range of *R. s. sumichrasti* from the Distrito Federal (Hooper, 1952), and it is the first Morelos record. *Record of occurrence:* Specimen examined, 1, from 1½ mi. SE Huitzilac.

Reithrodontomys chrysopsis chrysopsis Merriam. Volcano harvest mouse.—Our specimen is referred to *R. c. chrysopsis* because of its long bicolored tail, blackish ears, rich ochraceous color of upperparts, and the cinnamon colored underparts. The teeth were much worn and the subsidiary loops could not be observed with certainty, although there are indications of their presence.

Reithrodontomys chrysopsis evidently occupies higher altitudes than *R. sumichrasti* which inhabits the less humid Mixed Forest. This species, *R. chrysopsis*, is known only from the Boreal Forest where its preferred habitat is the thick clumps of sacaton bunchgrass. It apparently is not as abundant as *R. megalotis*. *Record of occurrence:* Specimen examined, 1, from 2 mi. W Huitzilac. Additional record: Huitzilac (Howell, 1914).

Peromyscus maniculatus fulvus Osgood. Deermouse.—Specimens collected in the Mixed Forest Association of the highlands are referrable to *P. m. fulvus*. In external and cranial measurements our specimens are typical of *P. m. fulvus*, which is smaller than *P. m. labecula* in size. Several specimens in our series from 10 mi. N Cuautla are rather dusky in color, as *P. m. labecula*, but the other specimens from this locality show the brighter russet and ochraceous upperparts of typical *P. m. fulvus*. We have not seen the three specimens from Yautepec referred to *P. m. labecula* by Osgood (1909), but in view of our specimens of *Peromyscus maniculatus* from Morelos we are assigning them to *P. m. fulvus*. A specimen from Tepoztlan, a short distance northwest of Yautepec, is typical of *P. m. fulvus* except in color. The specimens from Yautepec are the only records of *Peromyscus maniculatus* from the lowlands of Morelos.

A female taken 10 mi. N Cuautla in early June was lactating. Other specimens taken at this locality were molting; the new pelage is much lighter in color than the worn fur. These mice were common in the tall grass cover of an open field. *Records of occurrence:* Specimens examined, 8, as follows: 10 mi. N Cuautla, 7; 5 mi. W Tepozlan, 1. Additional record: Yautepec (Osgood, 1909).

Peromyscus maniculatus labecula Elliot. Deermouse.—Specimens collected in the Boreal and Mixed Forest of extreme northwestern Morelos are referrable to *P. m. labecula*. They match typical examples of *P. m. labecula* from other localities in Central Mexico in color and cranial characteristics; however, they are more like *P. m. fulvus* in external size. This is an indication of intergradation between *P. m. labecula* and *P. m. fulvus* in this area. Since they are more like *P. m. labecula*, we are referring our specimens to that race as have Osgood (1909) and Davis (1944).

These mice were rather common in the open, sacaton-grass-covered valleys and meadows of the Boreal Forest. They share this habitat with several other species including *Peromyscus melanotis*. A small series was also taken in the mixed forest 1½ mi. SE Huitzilac, mostly along rock fences that separate cultivated fields. At the latter locality they were associated with *Liomys irroratus minor* and *Peromyscus boylei levipes*. *Records of occurrence:* Specimens examined, 15, as follows: Huitzilac, 5; 2 mi. W Huitzilac, 1; 1½ mi. SE Huitzilac, 8; 5 km. N Tres Cumbres, 1. Additional record: Huitzilac (Osgood, 1909).

Peromyscus melanotis Allen and Chapman. Black-eared mouse.—These mice were common in the Boreal Forest Association, to which they apparently are restricted. They live among the clumps of tall sacaton grass in association with *Sorex vagrans*, *Reithrodontomys megalotis*, and *Neotomodon alstoni*. *Record of occurrence:* Specimens examined, 7, all from 5 km. N Tres Cumbres.

Peromyscus boylei levipes Merriam. Brush mouse.—This species seemingly is not of common occurrence in Morelos. We trapped our specimens along rock fences in the Mixed Forest Association. The two males taken June 12 and August 3 had enlarged testes denoting breeding condition. *Record of occurrence:* Specimens examined, 3, as follows: 2 mi. W Tepoztlan 1; 1½ mi. S Huitzilac, 2. Additional records: Cuernavaca and Tetela del Volcan (Osgood, 1909).

Peromyscus difficilis felipensis Merriam. Big-eared rock mouse.—Our series is typical of the subspecies *P. d. felipensis* as recorded by Osgood (1909). These large mice are abundant in the Boreal Forest Association where they favor rocky situations. Ours were trapped on a steep, rocky slope. The males were in breeding condition in late July. None of the females examined contained embryos. *Record of occurrence:* Specimens examined, 8, all from 2 mi. W Huitzilac.

Peromyscus melanophrys melanophrys Coues. Gray-cheeked rock mouse.—Although we refer these mice to *P. m. melanophrys*, they differ in having smaller cranial measurements than those listed for *P. m. melanophrys* by Osgood (1909). In cranial size our specimens agree more closely with *P. m. zamorae* from Michoacan; however, they lack the bright tawny pectoral markings characteristic of that race.

These mice are common in the arid lowlands of Morelos. They prefer rocky situations and make use of the rock fences that separate fields. We did not take them in the forested highlands, which probably are ecologic barriers to their dispersal.

A female, taken July 29 at Jonacatepec, had 3 uterine scars. Three males, two from Axochiapan and one from Alpuyeca, were in breeding condition in early August. Several half-grown, plumbeous colored juveniles were collected in July. *Records of occurrence:* Specimens examined, 26, as follows: 12 km. NW Axochiapan, 9; 2 km. S Jonacatepec, 10; Tlacotepec, 1; Cañon del Lobo (6 mi. W Yautepec), 2, 5 mi. W Tepoztlan, 1; 2 mi. SW Michapa, 1; Alpuyeca, 2. Additional records: Yautepec, Yecapixtla, and Cuernavaca (Osgood, 1909).

Baiomys musculus pallidus Russell. Pygmy mouse.—These mice, recently described by Russell (1952*a*), were most abundant along rock fences separating fields and in other rocky situations in the arid lowlands of Morelos. Seemingly they prefer this habitat. *Baiomys*

was the first small mammal to appear at night, and a number were caught in traps set just before nightfall. This crepuscular habit was also noted by Hall and Villa (1949). Specimens taken at Tepoztlan in the Mixed Forest were darker in color than those from lower elevations. Their dark color is not typical of the pale color of *B. m. pallidus*, but in other respects (size and cranial characteristics) they are similar. *Records of occurrence:* Specimens examined, 27, as follows; 12 km. NW Axochiapan, 6; 2 km. S Jonacatepec, 10; Cañon del Lobo (6 mi. W Yautepec), 1; 3 mi. W Alpuyeca, 2; 2 mi. SW Tepoztlan, 1; 5 mi. W Tepoztlan, 7. Additional records: Cuernavaca, Puente de Ixtla, and Yautepec (Osgood, 1909).

Oryzomys couesi aztecus Merriam. Coues rice rat.—Our one adult specimen, a female, differs from *O. c. aztecus*, as discussed by Goldman (1918), in the following characters: Narrower zygomatic breadth (16.2 mm. as compared with 17 mm.); shorter nasals (12.1 mm. as compared with 12.9 mm.); shorter palatal bridge (5.2 mm. as compared with 6.2 mm.). The specimen is referred to *O. c. aztecus* because of its long tail (longer than head and body), light ochraceous underparts, and the absence of prominent digital bristles.

The type locality of *O. c. aztecus* is Yautepec, Morelos, approximately 10 miles north of Temilpa, both of which localities are in the semi-tropical Yautepec River Valley. Specimens were trapped at the edge of a rice field.

Our female, trapped on August 21, weighed 74.8 grams, and contained 5 embryos. A young male, caught on August 22, weighed 20.5 grams and has the third upper molar just erupting. *Record of occurrence:* Specimens examined, 2 from Temilpa. Additional records: Cuernavaca, Puente de Ixtla, and Yautepec, (Goldman, 1918).

Sigmodon hispidus obvelatus Russell. Hispid cotton rat.—This race, recently described by Russell (1952*b*), averages smaller than *S. h. mascotensis*, as described by Bailey (1902). It differs in shorter total length (292.2 mm. as compared with 325 mm.); longer tail (140.7 mm. as compared with 117 mm.); shorter skull (greatest length 35.6 mm. as compared with 38.1 mm.); narrower zygomatic breadth (19.3 mm. as compared with 21.1 mm.); relatively smaller auditory bullae, and relatively smaller molar teeth. The underparts are whitish instead of buff.

Hispid cotton rats are not common in Morelos. They occur in the arid lowlands where they prefer areas with a thick grass cover. Two females collected in August near Alpuyeca contained 6 and 11 embryos, with crown-rump lengths of 62 to 64 mm. *Records of occurrence:* Specimens examined, 4, as follows: 5 mi. S Alpuyeca, 2; Cañon del Lobo (6 mi. W Yautepec), 1; 2 km. S Jonacatepec, 1. Additional records: Yautepec and Cuernavaca (Bailey, 1902).

Sigmodon alticola amoles Bailey. Mountain cotton rat.—The averages of two adult males differ from the measurements of one adult male of *S. a. amoles*, given by Bailey (1902), as follows: Wider zygomatic breadth (20.5 mm. as compared with 19.6 mm.); wider maxillary breadth (15.1 mm. as compared with 14.0 mm.); and slightly shorter maxillary tooth row (6.0 mm. as compared with 6.3 mm.). The presence or absence of a suture dividing the interparietal is not constant in our series. The suture is present in three specimens and absent in three and there is no correlation of age or sex with this character. Our specimens are darker in color than five specimens from Monte Rio Frio, Mexico, and the molar series converges anteriorly instead of being parallel.

The highlands of Morelos are isolated by arid regions from the high pine covered forest of Oaxaca where *Sigmodon a. alticola* occurs. It seems unlikely that the Morelos cotton rats, endemic to the Boreal Forest, have been connected geographically with that subspecies in Recent times. They also seem to differ significantly from *Sigmodon a. amoles*, described from the Pinal de Amoles in Queretaro. The cotton rats inhabiting the Boreal Forest of Morelos and the adjacent states probably represent an undescribed subspecies.

These cotton rats seemingly are not common. Half-grown young were caught in late July. *Records of occurrence:* Specimens examined, 6, as follows: Tres Cumbres, 2; 2 mi. W Huitzilac, 4.

Neotomodon alstoni alstoni Merriam. Volcano mouse.—These mice are the most abundant species inhabiting the sacaton grass community of the Boreal Forest Association, where they apparently are endemic.

One female, captured in July, had four embryos that measured 29 mm. in crown-rump length. A large number of half-grown individuals were collected in late July and early August.

Seemingly this is the first record of *Neotomodon alstoni* from Morelos. Specimens listed by Davis (1944) from Lago de Zempoala are from Mexico, incorrectly recorded as Morelos. *Records of occurrence:* Specimens examined, 107, as follows: 5 km. N Tres Cumbres, 99; 2 mi. W. Huitzilac, 8.

Neotoma torquata Ward. Ward wood rat.—The type locality for *N. torquata* is Tetela del Volcan in the Mixed Forest Association. Our specimens were collected in the Arid Tropical Scrub Association. This species was reported by Davis (1944) from Lago Zempoala, Mexico, in the Boreal Forest. The only other small terrestrial mammal in Morelos exhibiting such a wide ecologic tolerance is the Mexican cottontail, *Sylvilagus cunicularius*. *Record of occurrence:* Specimens examined, 3, from 2 km. S Jonacatepec. Additional record: Tetela del Volcan (Goldman, 1910).

Neotoma alleni elattura (Osgood). Fulvous wood rat.—The wood rats of this species were formerly recognized under the genus *Hodomys*. *Hodomys* has been reduced to subgeneric rank under the genus *Neotoma* (Burt and Barkalow, 1942), and Kelson (1952) shows evidence of intergradation between the species *Neotoma alleni* and *N. vetula*. The species name *Neotoma alleni* takes priority over *N. vetula*.

All three of our specimens are immature. They are tentatively referable to *Neotoma alleni elattura* on geographic grounds until additional adult specimens are available. It should be noted that the lower third molar in two specimens has a definite sulcus. A sulcus is not apparent in the other specimen, a slightly older individual. The tail of all three specimens is bicolored.

Our specimens, collected in a cave, were evidently a family group. Unfortunately we were unable to capture the adult. *Record of occurrence:* Specimens examined, 3, from Cañon del Lobo (6 mi. W Yautepec).

Microtus mexicanus mexicanus (Saussure). Mexican vole.—Our specimen, a young adult, is within the range of individual variation of *M. m. mexicanus*, and is referred to that subspecies. Compared with the description of *M. m. fundatus* (Hall, 1948), our specimen is smaller in size (total length, 133 mm. as compared with 147 mm.); the premaxillary border of the nasals are straight instead of concave; and cranial measurements are smaller.

This species is known in Morelos only from the Boreal Forest, where it lives in the clumps of sacaton grass, particularly in moist areas. *Record of occurrence:* Specimen examined, 1, from 5 km. N Tres Cumbres. Additional record: Huitzilac (Bailey, 1900).

Mus musculus brevirostris Waterhouse. House mouse.—These exotic mice are most common about the structures of humans. However, many are caught in the cultivated fields. At Huajintlan there was a high population of these mice living on the dikes in a rice field.

It is of interest to note that the mice collected at Huajintlan were darker, above and below, than mice captured in buildings at Alpuyeca. They were also heavier (18.3 grams as compared with 16.3 grams). *Records of occurrence:* Specimens examined, 6, as follows; Huajintlan, 2; Alpuyeca, 2; Temilpa, 2.

Rattus rattus alexandrinus Geoffrey. House rat.—These specimens are referred to *R. r. alexandrinus* on the basis of the long tail (longer than head and body), dark brown upper parts, and plumbeous underparts.

House rats are common about dwellings in the state. Their close association with human establishments is well known, but occasional individuals are taken in fields. *Records of occurrence:* Specimens examined, 4, as follows: Alpuyeca, 2; Temilpa, 2.

Lepus callotis Wagler. White-sided jack rabbit.—The white tipped ears, white sides and underparts, gray rump, and black upper part of the tail in this species is a very striking combination. These large jack rabbits range in the comparatively open desert shrub country in the arid lowlands of southeastern Morelos. They are not numerous and other than the one collected, only two others were seen. *Record of occurrence:* Specimen examined, 1, from Axochiapan. Additional record: Cuernavaca (Nelson, 1909).

Sylvilagus cunicularius cunicularius (Waterhouse). Mexican cottontail.—This is one of the few species in Morelos that has the ecologic tolerance to range in both the low arid association and the coniferous forest of the highlands. It prefers areas of grass and brush.

Our specimens are typical of *S. c. cunicularius* as described by Nelson (1909). Two males, one from the Boreal Forest and the other from the lowlands, were in breeding condition (July 28 and August 12, respectively). Rabbits were not common in Morelos because they are intensively hunted by the local residents. *Records of occurrence:* Specimens examined, 5, as follows: 2 mi. W Huitzilac, 2; 1½ mi. SE Huitzilac, 1; Alpuyeca, 1; 12 km. NW Axochiapan, 1. Additional records: Huitzilac, Cuernavaca, Yautepec, and Tetela del Volcan (Nelson, 1909).

Romerolagus diazi (Diaz). Volcano rabbit.—A number of these small rabbits were seen, but they are extremely difficult to approach, and we failed to bring back any specimens. They are fairly common in the Boreal Forest, living in the sacaton grass community. They quickly disappear in the thick clumps of bunch grass when disturbed.

Odocoileus virginianus mexicanus (Gmelin). White-tailed deer.—We were unable to collect deer in Morelos, but several were seen at Cañon del Lobo and southwest of Huitzilac. These deer are tentatively assigned to *O. v. mexicanus* on geographic grounds. Actual specimens must be examined before exact identification is possible. The occurrence of white-tailed deer within the state is well established, and they apparently occur sparingly throughout the wooded parts of the state, especially in the less accessible southern mountains.

Dasypus novemcinctus mexicanus Peters. Nine-banded armadillo.—Bailey (1905) described *D. n. texanus* with specimens from southwestern Texas. This race was later placed by Hollister (1925) in the synonomy of *D. n. mexicanus*. The type locality of *D. n. mexicanus* was not given by Peters. However, Hollister (1925) fixes it at Matamoras, Tamaulipas, Mexico.

Peters also described *D. n. fenestratus* from Costa Rica, a race that ranges northward into southern Mexico (Hooper, 1947). The morphological characteristics of this subspecies are well defined by Goodwin (1946: 350).

Our series from Morelos differs from *D. n. fenestratus* in the position of the suture between the jugal and squamosal bones. It is in front of, instead of behind, the posterior process of the upper border of the zygoma. This characteristic is used to separate *D. n. mexicanus* from *D. n. fenestratus*, and in this respect our specimens are like *D. n. mexicanus*. They differ from *D. n. mexicanus*, as known by six specimens from Texas, as follows: zygoma wider and shorter; palatine suture lies well behind last molars, instead of ahead or even with them; nasals narrower; greatest length of lacrimal bone, anterior to lacrimal foramen, 26 and 27 per cent of the nasal length in two adult males from Morelos, instead of 39, 39, 40, and 43 per cent as given by Hooper (1947) for four adults of *D. n. mexicanus*. Consequently, the armadillos of central Mexico probably represent an undescribed subspecies.

Armadillos are most abundant in the Boreal Forest of Morelos. One was collected in the Mixed Forest and another in the Tropical Deciduous Forest. Judging from sign, they are common along streams in the arid lowlands. They probably range out into the dry uplands in the favorable rainy season. *Records of occurrence:* Specimens examined, 4 as follows: 5 km. N Tres Cumbres, 2; 1½ mi. SE Huitzilac, 1; Tlacotapec, 1.

[Since the above notes were accepted for publication the following nomenclatural changes have appeared in print: (1) B. Villa R., 1952, Anales del Instituto de Biologia, 23: 325, has placed *Glossophaga soricina alticola* Davis in the Synonomy of *Glossophaga soricina morenoi* Martínez and Villa. (2) W. W. Dalquest, 1953, Proc. Biol. Soc. Washington, 66: 61–66, has placed *Artibeus toltecus toltecus* (Saussure) and *Artibeus aztecus* Andersen as subspecies of *Artibeus cinereus*. (3) R. J. Russell, 1953, Proc. Biol. Soc. Washington, 66: 21–26, named the armadillos of southwestern Mexico *Dasypus novemcinctus davisi*.]

LITERATURE CITED

Andersen, K. 1908. A monograph of the Chiropteron genera *Uroderma*, *Enchisthensis*, and *Artibeus*. Proc. Zool. Soc. London: 204–319.

BAILEY, V. 1900. Revision of American voles of the genus Microtus. N. Amer. Fauna, No. 17: 1–88.

———. 1902. Synopsis of the North American species of Sigmodon. Proc. Biol. Soc. Washington, 15: 101–116.

———. 1905. Biological survey of Texas: Life Zones, with characteristic species of mammals, birds, reptiles, and plants. N. Amer. Fauna, No. 25: 1–222.

BENSON, S. B. 1944. The type locality of Tadarida mexicana Saussure. Jour. Washington Acad. Sci., 34(5): 159.

BURT, W. H. 1949. Present distribution and affinities of Mexican mammals. Annals Assoc. Amer. Geog., 39: 211–218.

BURT, W. H. AND F. S. BARKALOW. 1942. A comparative study of the bacula of wood rats (subfamily Neotominae). Jour. Mamm., 23: 287–297.

BURT, W. H. AND E. T. HOOPER. 1941. Notes on the mammals from Sonora and Chihuahua, Mexico. Occas. Papers Mus. Zool. Univ. Mich., no. 430: 1–7.

DALQUEST, W. W., AND E. R. HALL. 1949. Five bats new to the known fauna of Mexico. Jour. Mamm., 30: 424–427.

DALQUEST, W. W., W. G. FRUM, AND E. R. HALL. 1950. A northern record for *Centronycteris mapimiliani centralis* with a key to the skulls of the North American emballonurine bats. Anales del Instituto de Biologia, Tomo XXI, Numero 2: 431–433.

DAVIS, W. B. 1944. Notes on Mexican mammals. Jour. Mamm., 25: 370–430.

GOLDMAN, E. A. 1910. Revision of the wood rats of the genus Neotoma. N. Amer. Fauna, No. 31: 1–124.

———. 1911. Revision of the spiny pocket mice (genera Heteromys and Liomys). N. Amer. Fauna, No. 34: 1–70.

———. 1918. The rice rats of North America (genus Oryzomys). N. Amer. Fauna, No. 43: 1–100.

———. 1938. List of the gray foxes of Mexico. Jour. Washington Acad. Sci., 28: 494–498.

———. 1942. Notes on the coatis of the Mexican mainland. Proc. Biol. Soc. Washington, 55: 79–82.

———. 1950. Raccoons of North and Middle America. N. Amer. Fauna, No. 60: 1–153.

GOODWIN, G. G. 1946. Mammals of Costa Rica. Bul. Amer. Mus. Nat. Hist., 87: 275–473.

HALL, E. R. 1948. Two new meadow mice from Michoacan, Mexico. Univ. Kansas Publ. Mus. Nat. Hist., 1: 423–427.

HALL, E. R., AND B. VILLA R. 1949. An annotated check list of the mammals of Michoacan, Mexico. Univ. Kan. Publ. Mus. Nat. Hist., 1: 431–472.

HERSHKOVITZ, P. 1949. Mammals of northern Columbia, preliminary report No. 5 (Chiroptera). Proc. U. S. Nat. Mus., 99: 429–454.

———. Mammals from British Honduras, Mexico, Jamaica and Haiti. Fieldiana: Zoology, 31, no. 47: 547–569.

HOLLISTER, N. 1925. The systematic name of the Texas Armadillo. Jour. Mamm., 6: 60.

HOOPER, E. T. 1947. Notes on Mexican mammals. Jour. Mamm., 28: 40–57.

———. 1948. Character gradients in the spiny pocket mouse, Liomys irroratus. Occas. Papers Mus. Zool. Univ. Mich., No. 514: 1–34.

———. 1949. Faunal relationships of Recent North American rodents. Misc. Publ. Mus. Zool. Univ. Mich., No. 72: 1–28.

———. 1952. A systematic review of the harvest mice (genus Reithrodontomys) of Latin America. Misc. Publ. Mus. Zool. Univ. Mich., No. 77: 1–255.

HOWELL, A. H. 1901. Revision of the skunks of the genus Chincha (Mephitis). N. Amer. Fauna, No. 20: 1–62.

———. 1906. Revision of the skunks of the genus Spilogale. N. Amer. Fauna, No. 26: 1–55.

———. 1914. Revision of the American harvest mice (genus Reithrodontomys). N. Amer. Fauna, No. 36: 1–97.

———. 1938. Revision of the North American ground squirrels, with a classification of the North American Sciuridae. N. Amer. Fauna, No. 56: 1–256.

JACKSON, H. H. T. 1928. A taxonomic review of the American long-tailed shrews (genera Sorex and Microsorex). N. Amer. Fauna, No. 51: 1–238.

KELSON, K. R. 1952. Comments on the taxonomic and geographic distribution of some North American woodrats. Univ. Kans. Publ. Nat. Hist., 5: 233–242.

LEOPOLD, A. S. 1950. Vegetation zones of Mexico. Ecol., 31: 507–518.

MARTINEZ, L. AND B. VILLA R. 1938. Contribuciones al conocimiento de los murcielagos de Mexico. Anales del Instituto de Biologia, Tomo IX, numero 3 and 4: 339–360.

———. 1940. Segunda contribucion al conocimiento de los murcielagos mexicanos. Anales del Instituto de Biologia, Tomo XI, numero 1: 291–361.

MERRIAM, C. H. 1895. Monographic revision of the pocket gophers, family Geomyidae (exclusive of the species of Thomomys). N. Amer. Fauna, No. 8: 1–258.

MILLER, G. S. 1902. Twenty new American bats. Proc. Philadelphia Acad. Nat. Sci.: 389–412.

———. 1913. Revision of the bats of the genus Glossophaga. Proc. U. S. Nat. Mus., 46: 413–429.

MILLER, G. S. AND G. M. ALLEN. 1928. The American bats of the genus Myotis and Pizonyx. Bul. U. S. Nat. Mus., No. 144: 1–218.

NELSON, E. W. 1899. Revision of the squirrels of Mexico and Central America. Proc. Washington Acad. Sci., 1: 15–110.

———. 1909. The rabbits of North America. N. Amer. Fauna, No. 29: 1–314.

OSGOOD, W. H. 1909. Revision of the mice of the American genus Peromyscus. N. Amer. Fauna, No. 28: 1–285.

REHN, J. A. G. 1902. A revision of the genus Mormoops. Proc. Acad. Nat. Sci. Philadelphia: 160–171.

———. 1904*a*. A revision of the mammalian genus Macrotus. Proc. Acad. Nat. Sci. Philadelphia: 427–446.

———. 1904*b*. A study of the mammalian genus Chilonycteris. Proc. Acad. Nat. Sci. Philadelphia: 181–207.

RUSSELL, R. J. 1952*a*. A new subspecies of pygmy mouse, Baiomys musculus, from Morelos, Mexico. Proc. Biol. Soc. Washington, 65: 21–22.

———. 1952*b*. A new cotton rat (genus Sigmodon) from Morelos, Mexico. Proc. Biol. Soc. Washington, 65: 81–82.

SANBORN, C. C. 1932. The bats of the genus Eumops. Jour. Mamm., 13: 347–357.

———. 1937. American bats of the subfamily Emballonurinae. Zool. ser., Field Mus. Nat. Hist., 20, no. 24: 321–354.

SHAMEL, H. H. 1931. Notes on the American bats of the genus Tadarida. Proc. U. S. Nat. Mus., 78: 1–27.

WARD, H. L. 1904. A study in the variations of proportions in bats, with brief notes on some of the species mentioned. Trans. Wisconsin Acad. Sci., Arts., and Ltrs., 14, pt. II: 630–654.

YOUNG, S. P., AND E. A. GOLDMAN. 1946. The puma, mysterious American cat. The Amer. Wildl. Inst., Washington, D. C. 358 p.

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DISTRIBUTION, TYPE LOCALITY, AND HABITS OF THE FISH-EATING BAT, *PIZONYX VIVESI*

By William G. Reeder and Kenneth S. Norris

Little is known concerning the distribution of the fish-eating bat, *Pizonyx vivesi* Menegaux. The range is usually given in general terms, as "Islands and coasts of the Gulf of California, Mexico" (Miller and Allen, 1928). Considerable hunting by various field parties has failed to disclose this bat over large areas of the ascribed range. The ecological conditions at the few localities from which this species has been obtained indicate restriction to a narrow range of habitat types.

New records and distribution.—On April 24, 1949, Mr. Ed N. Harrison and party were on Isla San Jorge, off Bahía de San Jorge, in the northern part of the Gulf of California. The members of the party were still in bed at dawn when an animal was seen to alight among the rocks on the hillside several yards away. Thinking it was a petrel, the rock under which the animal had disappeared was turned over, and instead of the expected bird, a specimen of *Pizonyx vivesi* was retrieved. The prepared specimen was presented to the Los Angeles County Museum (L.A.M. 9752). It is interesting that the animal returned to its shelter so late in the morning, since Burt (1932) indicated that the bats were in their rock-slide shelters before dawn. There are some indications that such late return was unusual, since Walker (1950) stressed the predatory activity of gulls and since attempts were made by duck hawks to capture bats released by him in daylight at various points on Isla Cardonosa. No undisturbed individuals in the colony observed by Burt were seen to fly during the day.

Mr. Jay M. Savage (*in litt.*) states that this bat was described to him by natives at Punta Peñasco, Sonora, just northwest of Isla San Jorge. He also saw them fishing in large numbers off shore near Bahía de San Carlos, a short distance north of Guaymas, Sonora.

On March 25, 1951, the junior author collected two specimens at Puerto San Bartolomé (Bahía Tortuga or Turtle Bay) which establishes the presence of the fish-eating bat on the western coast of the peninsula of Baja California. A single large bat, apparently *Pizonyx*, was noted on the evening of August 14, 1952, by the junior author, from the Scripps Institution Motor Vessel, *Paolina-T*, while the ship was anchored two miles off Punta Malarrimo, Bahía de Sebastian Vizcaino, Baja California. This locality is approximately 20 miles northeast of Puerto San Bartolomé.

The localities from which specimens of *Pizonyx* have been collected are: Isla Partida; Isla Tiburon; Guaymas; Isla Pescadora; Isla San Jorge; Puerto San Bartolomé; Isla Pond; Isla Encantada; Isla Granito off Puerto Refugio on Ángel de la Guarda Island; Puerto Refugio and Isla Patos (Fig. 1). Additional sight or circumstantial records, from Isla San Pedro Nolasco, Punta Malarrimo and Bahía de San Carlos, are also mapped. A sight record from Bahía San Francisquito was received too late for mapping.

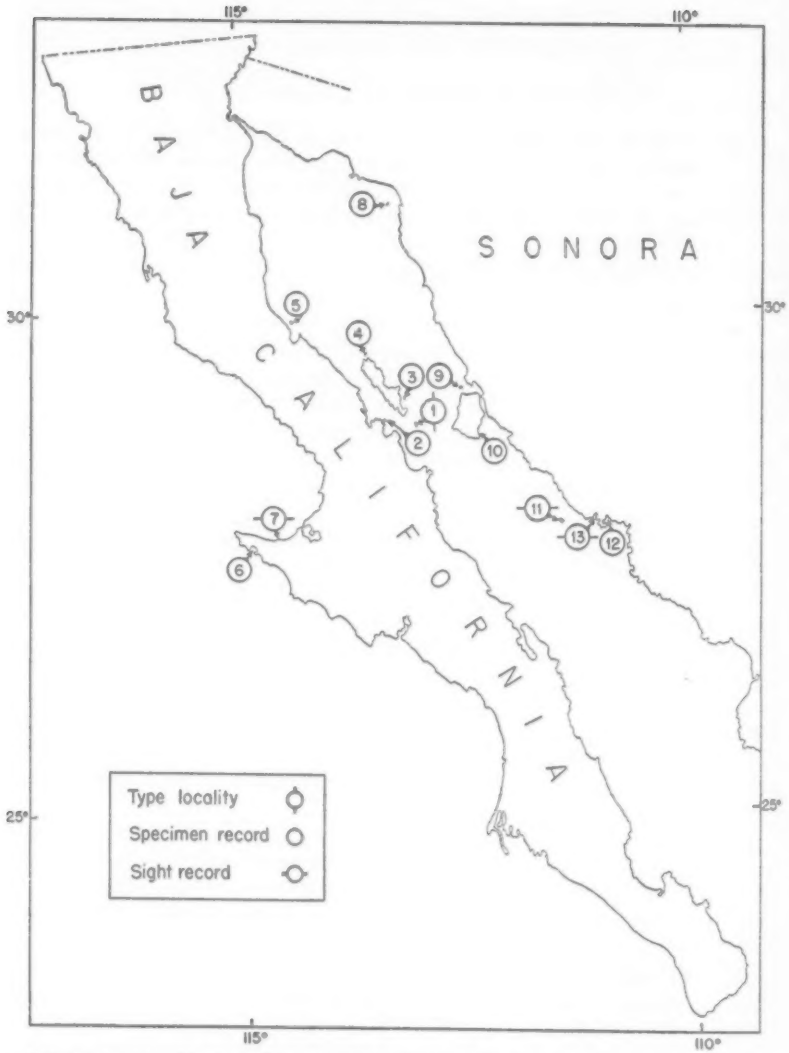

FIG. 1.—Coasts of Baja California and Sonora showing type locality, collecting localities, and sight records of the fish-eating bat *Pizonyx vivesi*. The localities are referred to by number: Baja California—1, Isla Partida; 2, Isla Pescadora; 3, Isla Pond; 4, Isla Granito, Puerto Refugio, Isla Ángel de la Guarda; 5, Isla Encantada; 6, Puerto San Bartolomé; 7, Punta Malarrimo. Sonora—8, Isla San Jorge; 9, Isla Patos; 10, Isla Tiburón; 11, Isla San Pedro Nolasco; 12, Guaymas; 13, Bahía de San Carlos. We wish to thank Mr. William L. Brudon, Museum of Zoology, University of Michigan, for the preparation of this map.

Thus the known range of the genus may be described as the coast of Sonora from the head of the Gulf of California south to Guaymas; islands of the Gulf of California from Isla San Jorge in the north to Isla San Pedro Nolasco in the south; east coast of Baja California from Bahía San Francisquito to Bahía de Los Angeles; the western coast of Baja California in the vicinity of Puerto San Bartolomé.

The following institutions or individuals have specimens of *Pizonyx*: American Museum of Natural History; British Museum (Natural History); California Academy of Sciences; Chicago Natural History Museum; Hancock Foundation, University of Southern California; Los Angeles County Museum; Mr. Laurence M. Huey; Museum of Vertebrate Zoology; San Diego Museum of Natural History; Dickey Collection, University of California, Los Angeles; University of Michigan, Museum of Zoology; United States National Museum; Muséum National d'Histoire Naturelle, Paris.

For aid in determining the records and distribution of this bat we extend grateful thanks to the following persons and institutions: Hobart M. Van Deusen, American Museum of Natural History; T. C. S. Morrison-Scott, British Museum (Natural History); Robert T. Orr, California Academy of Sciences; Colin C. Sanborn, Chicago Natural History Museum; John S. Garth, Hancock Foundation, University of Southern California; Kenneth E. Stager, Los Angeles County Museum; Laurence M. Huey, San Diego Museum of Natural History; Jay M. Savage, Natural History Museum, Stanford University; Viola S. Schantz, United States Fish and Wildlife Service; Henry W. Setzer, United States National Museum; Seth B. Benson, Museum of Vertebrate Zoology, University of California; George A. Bartholomew, Thomas R. Howell and Roy J. Pence, University of California, Los Angeles; William H. Burt, Museum of Zoology, University of Michigan.

Type locality.—The type locality of *Pizonyx vivesi* was given by Menegaux (1901) as "Ilot du Cardonal ou Islo, partie de L'Archipel Salsi puedes, au nord du golfe de Californie." The two cotypes were both originally deposited in the Paris Museum, but one is now in the collections of the British Museum.

McLellan (1927) and Miller and Allen (1928) indicate that Isla Cardonal is about 12 miles south of Isla Partida and others have repeated the statement, but there is no island in that position. Salsipuedes, the northernmost of the three islands comprising the archipelago of the same name is about that distance approximately southeast of Isla Partida. The two other islands, still farther southeast, are Isla de las Animas and Isla San Lorenzo. About six miles southeast of Isla Partida, between that island and Isla Salsipuedes, is tiny Isla Raza. Approximately nine miles northwest of Isla Partida is the southern end of the large island, Ángel de la Guarda.

In 1932, William H. Burt, in the company of J. R. Pemberton, tramped over and collected on each of the islands of this region. *Pizonyx* was found in numbers on Isla Partida, but was not collected on the other islands. Bat feces were noted by Burt on the rather distant Isla San Pedro Nolasco. Broken rock slides, the most typical habitat of this bat, were found only on Isla Partida and Ángel de la Guarda (Pl. I).

PLATE 1

Isla Partida, the type locality of *Pizonyx vivesi*. Note the dense stands of Cardon cactus. Fish-eating bats were found under rocks in the slide at the left. Photograph by A. A. Allanson.

The name Isla Cardonal is obviously derived from the cardon cactus, which presumably abounds on the island for which it is the namesake. Isla Partida and Ángel de la Guarda are the only islands in the vicinity which, according to reports, support considerable stands of this large cactus.

The facts that the six islands lie in an almost straight northwest-southeast line and are roughly equidistant from the coast of Baja California indicate that although only the southern three are correctly allocated to the Salsipuedes Archipelago, any one of the six, from Ángel de la Guarda to Isla San Lorenzo might be referred to casually as a member of this series. Diguet (1912), the collector of the cotypes, never included Ángel de la Guarda in his designation of "los islotes de Sal si puedes" and this would seem to rule out this northern island as the type locality.

In the American Museum of Natural History are three alcoholic specimens, also collected by M. L. Diguet, bearing the data: "Island of Cardonal or Archangel, Northern part of the Gulf of California, October 1900." Whether the "or" reflects a question as to which of the two localities is correct or indicates a duplication of names from one island is not known. The former alternative seems the more likely, since Ángel de la Guarda has been termed "Archangel"

and Diguet is known to have visited that locality as well as another that he called Isla Cardonal. In any event, it is possible that these specimens are exact topotypes, though the cotypes collected by Diguet were obtained in the month of December of the same year.

Mr. A. A. Allanson of Scripps Institution of Oceanography visited the island now known both as Isla Partida and Isla Cardonosa. Both names were applied to the same small island, though apparently the latter name, very similar in etymological derivation to the "Ilot du Cardonal" of the type description, is most used by residents of the region.

On the basis of the evidence cited above Isla Partida, at 28° 53′ N. lat., 113° 04′ W. long., the locality most prolifically inhabited by *Pizonyx vivesi* appears to be the equivalent of Ilot du Cardonal, Isla Cardonal and Isla Cardonosa, and may be regarded as the type locality. This island, readily located on modern maps of the region, is not to be confused with Isla Partida of the Espiritu Santo group, at the entrance to La Paz Bay.

Feeding habits.—On the evening of March 25, 1951, the junior author had an unusual opportunity to observe *Pizonyx* in the act of feeding. The *Paolina-T* was anchored in the nearly circular harbor of Puerto San Bartolomé (Turtle Bay), Baja California del Sur, Mexico. A flood lamp, suspended from the after boom of the ship cast a circle of light about 50 yards in radius on the water. An hour or so after sunset about two dozen large bats were noted circling in and out of this cone of light. Two, shot in flight with a .22 caliber shot pistol, were retrieved and preserved as alcoholics.

As they circled in flight, the bats periodically curled their long tails downward and forward and momentarily dipped them into the water, not rhythmically, but at irregular intervals of several seconds. One bat flew over the water holding a shining little fish in its hind feet. The stomachs of the two bats that were killed were filled with small crustacea. There was no noticeable concentration of such invertebrates in the water on this night, though a light suspended in the water attracted considerable numbers of small atherinid fishes (*Atherinops affinis*) and small anchovies (*Engraulis mordax*). George A. Bartholomew examined the stomachs of three bats captured at Puerto Refugio, Angel de la Guarda Island. Two were empty and the third contained many fragments of insects.

How these bats detect and capture their marine prey is an interesting and unsettled question. Miller and Allen (1928) and Burt (1932) speculated that the long thin recurved claws on the hind feet serve to capture small fishes or crustacea while the bat is in flight. After having observed that a single V-shaped ripple was left as these bats swooped low over the water during feeding, Walker (1950) surmised that this trail was left by the animal's chin as it cruised down to capture jumping crustaceans and believed that the claws played no part in the capture of prey. The posture of feeding bats observed at Puerto San Bartolomé was reminiscent of that of an ovipositing dragon fly; the head was held high with the tail curled forward under the animal's body. Similar behavior was described by Beebe (1941) for *Noctilio leporinus*: "Twice a bat seemed actu-

ally to seize the small fish in mid air as it jumped, but usually the position of the bat was obliquely upright, and the strong-gripping hind claws may have functioned." Gudger (1945), quoting Charles Kingsley, Gifford Pinchot, and others, indicated that *Noctilio* employs the interfemoral membranes as a scoop and possibly uses the feet as an aid in obtaining aquatic prey. The single V-shaped wake observed by Walker was obviously produced by the animal's tail and not by its chin.

The calcar cartilages, which extend inward from each hind foot into the uropatagium, no doubt hold this pouch open when the tail is dipped into the water. The flattened form of the long claws suggests that they may be dipped into the water at times during fishing, as postulated by Miller and Allen. Perhaps these claws serve primarily, as do the rictal bristles of nighthawks and poor-wills, to shunt prey into the pouch. The long, thin, and dexterous hind feet probably pick the prey from the pouch, to be eaten while the bat is in flight. How small fishes and crustaceans are detected is unknown. The bats in Turtle Bay were seen dipping their tails into the water far out into the shadowy darkness, where the light must have been very faint. Phosphorescence seemed to be absent. The irregularity of fishing movements would seem to indicate that these bats received some sensory cue from their prey and that capture is not a result of random dipping. It is interesting that these bats also catch insects, in view of the probability that methods used are different from those employed to catch fishes and crustacea.

Walker (1950) says: "From evidence that is purely circumstantial, I believe that their diet consists of small shrimp. Whole schools of these crustaceans will occasionally skim the surface when frightened, thus creating the same agitation that I saw preceding the flight of the bats. Some fish of the region also skim the surface, but as a rule their actions are due to fright from below and not from above. The white breast and underparts of these fish bats are unique for their tribe. Most of the other members of the family are a somber color which helps them to blend with the darkness. . . . The jumping crustaceans or fish would presumably see a white object approaching more easily than a dark body, and in their fright would leap from the water and become available for flying mammals." Though this mode of fishing was not observed at Puerto San Bartolomé, it may well occur when crustaceans school abundantly.

Remarks on young and on parasites.—Burt (1932) and Walker (1950) have both noted that in early June females of *Pizonyx* usually carry a single young attached to one of the two pectoral teats. Through the courtesy of Mr. Laurence M. Huey we have checked the 27 specimens, all females, collected on May 1, 1948, by Lewis Walker on Isla Pescadora. Museum notes indicate that each contained a single embryo, 10–35 mm. long.

The Puerto San Bartolomé specimens harbored many flightless dipteran ectoparasites (Nycteribiidae) of the species *Basilia pizonychus*. The identification was made by Mr. William A. McDonald, Department of Entomology, University of California, Los Angeles. No internal parasites were detected.

LITERATURE CITED

BEEBE, W. 1941. Fish-eating bats in the Orinoco delta. Bul. N. Y. Zool. Soc., 44: 30-31.

BURT, W. H. 1932. The fish-eating habits of *Pizonyx vivesi* (Menegaux). Jour. Mamm., 13: 363-365.

DIGUET, L. 1912. Territorio de la Baja California. Librería de la Vda de D. Bouret, Paris and Mexico City. 40 p.

GUDGER, E. W. 1945. Fishermen Bats of the Caribbean region. Jour. Mamm., 26: 1-15.

MCLELLAN, M. E. 1927. *Pizonyx vivesi* on Isla Partida, Gulf of California. Jour. Mamm., 8: 243.

MENEGAUX, M. A. 1901. Description d'une variété et d'une espèce nouvelles de Chiroptères rapportées du Mexique par M. Diguet. Bul. Mus. d'Hist. Nat., Ser. 1, 7: 321-327.

MILLER, G. S., AND G. M. ALLEN. 1928. The American bats of the genera *Myotis* and *Pizonyx*. Bul. U. S. Nat. Mus. 144: 209-214.

WALKER, L. W. 1950. The fish bats of Pescadora. Audubon Mag., 52: 294-299.

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TAXONOMY OF THE CHICKAREES (*TAMIASCIURUS*) OF UTAH

BY STEPHEN D. DURRANT AND RICHARD M. HANSEN

Students of taxonomy and distribution of mammals of western United States have long pondered over the nomenclatural assignments and geographical occurrences of members of the genus *Tamiasciurus*. The extreme variability in color and cranial details of animals occurring throughout the intermountain region has made the study perplexing and at times has rendered exceedingly difficult the assignments of animals to the lower taxonomic categories. This is especially true in animals from Utah, which in many ways could be considered a "melting pot" for chickarees and many other kinds of mammals. These forementioned difficulties were evident as early as 1877. At that time, J. A. Allen placed all members of the genus in one species. Later, Allen (1898) recognized as tenable the several species he had previously synonymized. His reasons for the latter action were that, although he had more specimens than in 1877, he possessed none which he considered to be an intergrade. From 1898 until 1950, animals from Utah were recognized as belonging to two species, *Sciurus* (or *Tamiasciurus*) *hudsonicus* and *Sciurus* (or *Tamiasciurus*) *fremonti*. In 1937, A. H. Howell (personal communication with S. D. Durrant), while studying animals from the western part of the Uinta Mountains of Utah, suspected intergradation to exist between animals supposedly belonging to the two species mentioned. As a result of the many now known intergrades between these previously supposed full species, Durrant (1952), Hardy (1950), Kelson (1951), and Hansen (MS) are in essential agreement that the animals from Utah belong to the single species *Tamiasciurus hudsonicus*, and that *Tamiasciurus fremonti* is a subspecies of the earlier named *Tamiasciurus hudsonicus*.

At present, four names are applied to animals from Utah—*Sciurus* [*Tamia-*

sciurus] *hudsonicus ventorum* (Allen), for those from the Wasatch Mountains; *Sciurus fremonti* [*Tamiasciurus hudsonicus*] *fremonti* (Audubon and Bachman), for those from the eastern, northeastern and central mountains; *Tamiasciurus hudsonicus wasatchensis* Hardy, for those from Mount Nebo and the Wasatch Plateau; and *Tamiasciurus fremonti* [*hudsonicus*] *dixiensis* Hardy, for those from the south central and southwestern mountains.

In attempting to assign his specimens from Mount Nebo to subspecies, Hansen (MS) noted an extremely wide range of individual variation in them. Moreover, the majority of the animals demonstrated intergradation in both color and cranial details between *T. h. ventorum* and *T. h. fremonti*, while some proved to be three-way intergrades between the above-mentioned two subspecies and *T. h. dixiensis*. This raised a perplexing problem inasmuch as Hardy (1950: 13) described *T. h. wasatchensis* and gave the type locality as "about 10,000 feet in spruce-fir area along Skyline Drive [Nebo Scenic Loop Road], east of Mount Nebo, Juab County, near Juab-Utah County line, Utah." He ascribed a range including Mount Nebo and the Wasatch Plateau to his newly described subspecies. The above-mentioned different interpretations of the status of animals from Mount Nebo, and the existence of discrepancies between Durrant (1952) and Kelson (1951), caused us to deem it advisable to reconsider and restudy all the chickarees of Utah. Furthermore, Stanley P. Young advised us (correspondence) that the U. S. Fish and Wildlife Service, United States National Museum, was completing the revision of the genus *Tamiasciurus* begun by the late A. H. Howell. In order that the students of western mammals might have the results of our study, and in view of the forementioned differences in the understanding of the taxonomic assignments of animals from Utah, we felt this report to be timely.

This study is based upon 204 specimens from Utah, and 34 from Colorado, Arizona and New Mexico (Fig. 1), which is a considerably larger number than has been available to previous writers. For the loan of specimens we are indebted to Stanley P. Young and Viola S. Schantz, United States Fish and Wildlife Service, Washington, D. C.; Howard Knight, Weber Junior College, Ogden, Utah; C. Lynn Hayward, Department of Zoology, Brigham Young University, Provo, Utah and J. S. Stanford, Department of Zoology and Entomology, Utah State Agricultural College, Logan, Utah. Unless otherwise indicated, all specimens are in the collections of the Museum of Zoology, Department of Vertebrate Zoology, University of Utah. Specimens from other institutions are indicated as follows: (BYU)—Department of Zoology, Brigham Young University; (WJC)—Weber Junior College; (USAC)—Department of Zoology and Entomology, Utah State Agricultural College; (USNM)—United States National Museum.

All measurements are in millimeters and all capitalized color terms are after Ridgway (1912).

This study indicates that the chickarees in Utah belong to three subspecies of the species *Tamiasciurus hudsonicus*. The taxonomic assignments and detailed accounts follow.

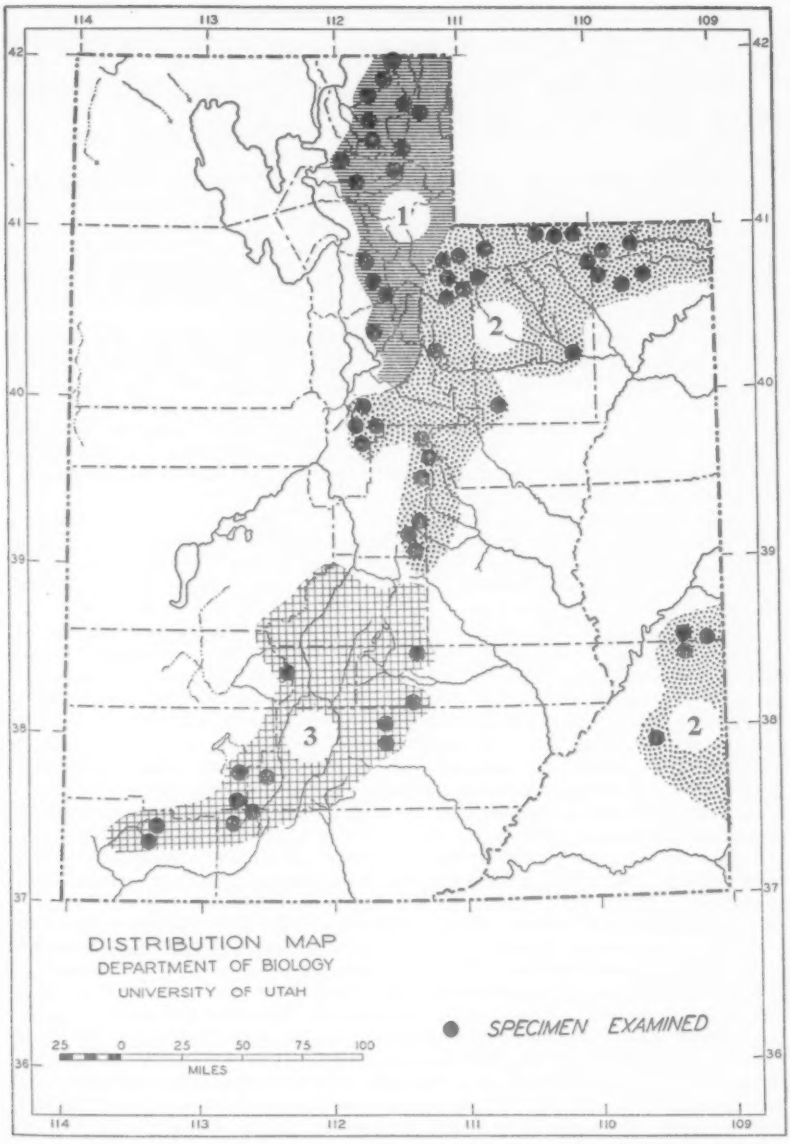


FIG. 1.—Distribution of *Tamiasciurus hudsonicus* in Utah. Guide to subspecies: 1. *T. h. ventorum*; 2. *T. h. fremonti*; 3. *T. h. dixiensis*.

Tamiasciurus hudsonicus ventorum (Allen)

Sciurus hudsonicus ventorum Allen, Bul. American Mus. Nat. Hist., 10: 263, July 22, 1898, type from Pass City, Wyoming.

Tamiasciurus hudsonicus ventorum, Davis, THE RECENT MAMMALS OF IDAHO, Caxton Printers, Caldwell, Idaho, p. 229, April 9, 1939.

Range.—Northern Wasatch Mountains as far south as Spanish Fork Canyon, Utah County, Utah.

Remarks.—Members of this subspecies in Utah are the most characteristic and easily recognizable of any within the state. Typical representatives are characterized by: Upper parts between Dresden Brown and Buckthorn Brown owing to banding of hairs (bands usually seven in number, five in some hairs); lateral line dusky, nearly obsolete; hairs of tail tipped with Ochraceous-Buff or Antimony Yellow; skull angular; nasals short and widely flaring distally; rostrum short and wide; zygomatic arches robust, angular; zygomatic breadth wide; tympanic bullae large.

Typical representatives of *T. h. ventorum* may be distinguished from those of *T. h. fremonti* and *T. h. dixiensis* by more buffy upper parts; tips of hairs of tail Ochraceous-Buff or Antimony Yellow as opposed to white; dusky, nearly obsolete lateral line as opposed to strongly marked, black, lateral line; more massive supraorbital ridges and postorbital processes; nasofrontal suture not posterior to frontopremaxillary suture in majority of specimens (70 per cent), while it is posterior in majority of specimens of *T. h. fremonti* and *T. h. dixiensis* (80 per cent); tympanic bullae larger and more inflated ventrally; dorsal outline of skull caudad of coronal suture less convex.

Intergradation between animals belonging to *T. h. ventorum* and *T. h. fremonti* occurs freely wherever the ranges of the two subspecies come in contact. Intergrades are readily recognizable by several characters, the chief one being the color of the tips of the hairs of the tail. In the same animal, some hairs are tipped with Ochraceous-Buff or Antimony Yellow (like *T. h. ventorum*), while others are tipped with white (like *T. h. fremonti*).

Animals from the Wasatch Mountains proper, within the range of *T. h. ventorum*, are typical representatives of this subspecies. From the Wasatch Mountains eastward into the western part of the Uinta Mountains the approach toward *T. h. fremonti* is progressively greater both in skin and cranial details. Eastward through the Uinta Mountains, toward Colorado, there is a progressive approach toward *T. h. fremonti*, until upon reaching the eastern Uinta Mountains, nearly all animals are typical of *T. h. fremonti*. Hence, the middle and western parts of the Uinta Mountains constitute a wide zone of intergradation between these two subspecies. The animals from this region, while being intermediate in color between *T. h. ventorum* and *T. h. fremonti*, are referable to the latter in the majority of the diagnostic characters, especially in the reduced size of the auditory bullae. The dorsal outline of the skull and rostrum are reminiscent of *T. h. ventorum*. Another zone of marked intergradation is in the area of Mount Nebo, in eastern Juab County. Here, three-way intergradation occurs between *T. h. ventorum*, *T. h. fremonti* and *T. h. dixiensis* (for details, see discussion under *T. h. fremonti*). This type of intergradation which occurs in animals from Mount Nebo is reflected in specimens from Mount Timpanogos, which lies approximately 50 miles to the north of Mount Nebo. Fifteen specimens were collected at Mount Timpanogos on August 29, 1937, and were prepared by James W. Bee. These specimens are all in the collections of Brigham Young University. It is noteworthy that of the 15 specimens, numbers 1071 and 1072 have the appearance typical of *T. h. ventorum* with no evidence of intergradation. The remainder, while being referable in the majority of characters to *T. h. ventorum*, do possess characters of *T. h. fremonti*. Number 1070 has the upper parts heavily suffused with black like *T. h. fremonti*. Although not as nearly intermediate in color between *T. h. ventorum* and *T. h. fremonti* as are specimens from Mount Nebo, in cranial details the animals from Mount Timpanogos are intermediate between *T. h. ventorum* and *T. h. fremonti* in the position of the frontopremaxillary suture with reference to the nasals, in dorsal outline of rostrum and braincase, and in the size and shape of the auditory bullae. All things considered, these specimens from Mount Timpanogos are best referred to *T. h. ventorum*.

Critical evaluation of the intergradational features clearly indicates that these specimens from Mount Timpanogos differ from those from Mount Nebo only in degree, and not in kind of intergradation. This lesser degree is to be expected on the basis of distribution, since the animals from Mount Timpanogos are from 50 miles north of Mount Nebo, and within the range of *T. h. ventorum*. Further indication of this type of intergradation is noted in specimens from east of Salt Lake City, which show even less approach toward *T. h. fremonti* than do those from Mount Timpanogos.

Specimens examined.—Total, 75, distributed as follows: *Cache County*: Utah-Idaho Line, Logan Canyon, 1 (USAC); Rover Camp, 25 mi. up Logan Canyon, 1 (USAC); Spring Hollow, Logan Canyon, 2 (USAC); Upper Mill Hollow, Logan Canyon, 4 (USAC); Lower Mill Hollow, Logan Canyon, 1 (USAC); Little Bear Creek, Logan Canyon, 1 (USAC); Tony Grove, Logan Canyon, 7 (USAC); Beaver Creek, Logan Canyon, 1 (USAC); Logan Canyon, 6,000 ft., 2 (1, BYU); Cache-Rich Summit, Logan Canyon, 1 (USAC); N. side Logan Peak, 8,000 ft., 1 (USAC); Head of Providence Canyon, 2 (USAC); Anderson Ranch, Blacksmith Fork, 5,500 ft., 1. *Rich County*: Between Laketown and Blacksmith Fork, 1; Monte Cristo, 5 (3, WJC); Old Canyon, 6 mi. W Randolph, 8,000 ft., 1. *Weber County*: Mt. Willard, Weber-Boxelder County line, 2; Ogden Canyon, Pineview Dam, 1 (WJC); South Fork Canyon, 1; Squaw Flat, 35 mi. E Ogden, SE Monte Cristo, 2; Snow Basin Road, Wheelers Canyon, 9 mi. E Ogden, 1; Wheelers Canyon at entrance to Snow Basin, 9 mi. E Ogden, 1; Wheelers Canyon, 2 mi. S Pineview Dam, 1; Snow Basin, near ski lift, 9 mi. E Ogden, 1. *Salt Lake County*: The Dam, Parleys Canyon, 1; Mountair Resort, 8 mi. up Parleys Canyon, 6,400 ft., 1; 10 mi. above lower powerhouse, rd. to Cardiff Mine, Big Cottonwood Canyon, 1; Big Cottonwood Canyon, "the Spruces", 7,400 ft., 2; Big Cottonwood Canyon, 1 mi. above "Spruces", 7,400 ft., 1; Big Cottonwood Canyon, 1 mi. E "Spruces", 1; Silver Lake Post Office (Brighton), 9,000 ft., 8. *Utah County*: Aspen Grove, Mount Timpanogos, 15 (BYU); Altimont, Mount Timpanogos, 1 (BYU); Stewart Flat, Mount Timpanogos, 1 (BYU); Pole Canyon, Mount Timpanogos, 1 (BYU).

Tamiasciurus hudsonicus fremonti (Audubon and Bachman)

Sciurus fremonti Audubon and Bachman, Quad. N. America, 3: 237, 1853, type from Colorado (see Allen, 1898: 289–290).

T. [amiasciurus] hudsonicus fremonti, Hardy, Proc. Biol. Soc. Washington, 63: 14, April 26, 1950.

Tamiasciurus hudsonicus wasatchensis Hardy, Proc. Biol. Soc. Washington, 63: 13, April 26, 1950, type from "about 10,000 feet, in spruce-fir area along Skyline Drive [Nebo Scenic Loop Road] east of Mount Nebo, Juab County near Juab-Utah County line, Utah."

Range.—Uinta, southern Wasatch, La Sal and Abajo mountains, Wasatch and East Tavaputs plateaus and the higher elevations of Uintah Basin.

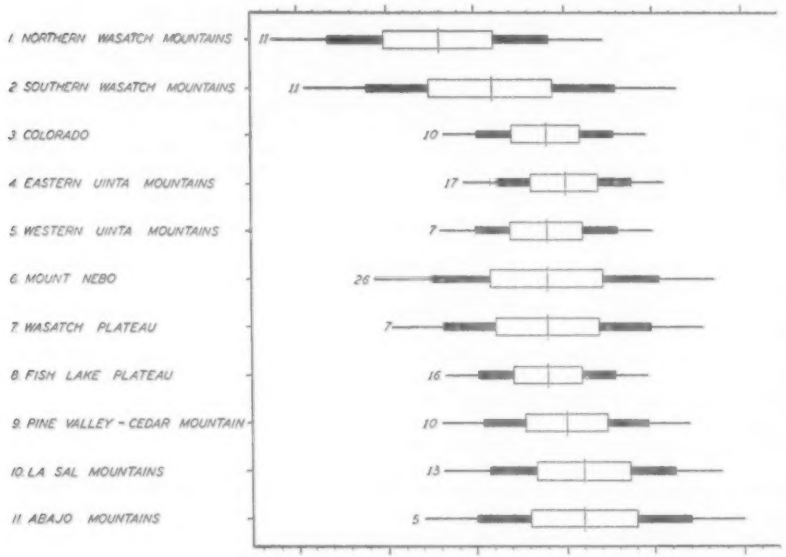
Remarks.—Typical representatives are characterized by: Upper parts Dresden Brown (general tone), owing to mixture of gray and Ochraceous-Buff (hairs usually with 5 bands); hairs of tail tipped with white; lateral line black; nasals extend posterior to frontopremaxillary suture; auditory bullae small; sides of rostrum parallel.

Animals belonging to *T. h. fremonti* are distinguishable from those belonging to *T. h. dixiensis* by smaller size, shorter hind foot, lighter color of upper parts, shorter skull, shorter nasals, wider zygomatic breadth, more widely flaring zygomatic processes of squamata, less ventrally directed zygomatic processes of squamata, proportionally wider preorbital plates of maxillae, narrower interpterygoid space, and generally shorter measurement of the upper molariform series. For differences with *T. h. ventorum*, see account of that subspecies.

As already mentioned, chickarees from the area of Mount Nebo, in eastern Juab County, are difficult to assign to subspecies. Durrant (1952) considered them to be intergrades between *T. h. ventorum* and *T. h. fremonti*, but referable to the former, while Kelson (1951) referred these intergrades to *T. h. fremonti*, as did Hansen (MS). Hardy (1950: 13–14) made the first critical study of animals from Mount Nebo itself, and thought them distinctive

enough to merit the new name *Tamiasciurus hudsonicus wasatchensis*. The confusion resulting from these varied opinions caused the junior author to obtain more specimens from the area assigned to the supposed new subspecies *T. h. wasatchensis*. In all, 39 specimens (23 more than were available to Hardy) were obtained from the range ascribed to *T. h. wasatchensis*. These specimens were subjected to critical study over a long period of time. When topotypes and paratypes of the supposed *T. h. wasatchensis* are compared with those of *T. h. ventorum* and *T. h. dixiensis* and with specimens of *T. h. fremonti* from Colorado, we note the following: Skull longer than *T. h. fremonti*, but shorter than *T. h. ventorum* or *T. h. dixiensis*; zygomatic breadth narrower than *T. h. ventorum* or *T. h. fremonti*, but similar to *T. h. dixiensis*; length of nasals intermediate between *T. h. ventorum* and *T. h. fremonti* or *T. h. dixiensis*; length of rostrum shorter than *T. h. ventorum*, but within the range of *T. h. fremonti* and *T. h. dixiensis*; auditory bullae smaller than *T. h. ventorum*, but similar to *T. h. fremonti*; interpterygoid space like *T. h. fremonti*; dorsal outline of zygomatic arches intermediate between *T. h. ventorum* and *T. h. fremonti*, but unlike *T. h. dixiensis*; shape of rostrum in all respects intermediate between *T. h. ventorum* and *T. h. fremonti*; dorsal outline of skull intermediate between *T. h. ventorum* and *T. h. fremonti*.

We measured the width of the palate between the second and third molars in all speci-



	1	2	3	4	5	6	7	8	9	10	11
MEAN	78	81	84	85	84	84	84	84	85	86	86
STANDARD DEVIATION	031	035	019	019	020	032	029	019	023	026	030
STANDARD ERROR	001	011	007	005	008	006	012	005	007	007	015

FIG. 2.—The range of variation as shown by the ratio of the length of the nasals to the length of the rostrum in samples of *Tamiasciurus hudsonicus*. The perpendicular lines are the means. The open rectangles represent one standard deviation either side of the mean; the solid rectangles represent two standard deviations either side of the mean; the horizontal lines represent three standard deviations either side of the mean. Numerals adjacent to the horizontal lines indicate the number of specimens examined.

mens studied and found nothing of significance. In order to check our observations, we treated much of the measurement data by statistical methods. Most analyses showed nothing of significance. In plotting the ratio of the length of the nasals to the length of the rostrum, however, we did find statistically valid evidence that animals from Mount Nebo were intergrades of the type already mentioned. In animals from Mount Nebo, three standard deviations plus or minus from the mean (which encompasses 99.8 per cent of the variation) practically encompassed the entire range of variation of all populations of all subspecies studied; and the mean itself was the same as that of specimens of *T. h. fremonti* from Colorado (Fig. 2).

Specimens from Mount Nebo and environs are highly variable in color, 50 per cent resemble *T. h. fremonti*, 30 per cent resemble *T. h. ventorum*, and 20 per cent resemble *T. h. dixiensis*. Hardy (1950: 13–14) stated that animals from Mount Nebo had "rustier" tails and hind feet than did those belonging to *T. h. dixiensis*. This is true for some specimens, and is to be expected because this "rustier" color is reminiscent of animals belonging to *T. h. ventorum*, and Mount Nebo is located geographically closer to the range of *T. h. ventorum*. In our judgment, the animals from Mount Nebo are intermediate in the color of these parts between the Ochraceous-Buff of *T. h. ventorum* and the lighter (whitish) color of *T. h. fremonti* and *T. h. dixiensis*. Furthermore, Hardy (*loc. cit.*) stated that the white frosting of the tail in some specimens from Mount Nebo was not as extensive as in specimens of *T. h. fremonti* and *T. h. dixiensis*. In specimens available to us, comparisons show this white frosting to be only less frequent but not less extensive. As Hardy (*loc. cit.*) says, specimens from Mount Nebo have dark heads, but we found them to be neither darker than in *T. h. dixiensis* nor in selected specimens of *T. h. fremonti*. The emphasis placed upon the darker tip of the tail in animals from Mount Nebo is likewise inconclusive, because all degrees of darkness are exhibited throughout the several series studied from elsewhere. The color of the sides of the nose is intermediate in the specimens from Mount Nebo between the Cinnamon-Buff color of *T. h. ventorum* and the whitish color of *T. h. fremonti*. In color, the animals from Mount Nebo are indistinguishable from those from the western end of the Uinta Mountains which are known to be intergrades between *T. h. ventorum* and *T. h. fremonti*, but referable to the latter.

We were unable after exhaustive study of this large series of topotypes of *T. h. wasatchensis* to find any characters of sufficient worth or constancy to merit recognizing *Tamiasciurus hudsonicus wasatchensis* as a valid subspecies. It might be said that the only distinction enjoyed by the chickarees from Mount Nebo and environs is that they possess the widest range of variation of any population studied, and this is known tr be distinctive of intergrading populations. Furthermore, K. R. Kelson and Durrant examined the type specimen of *T. h. wasatchensis* in the United States National Museum and agree that it is an intergrade between *T. h. ventorum* and *T. h. fremonti*, and is referable to *T. h. fremonti*. All things considered, we are convinced that animals from Mount Nebo are intergrades between *T. h. ventorum*, *T. h. fremonti* and *T. h. dixiensis*, and in the majority of characters are referable to *T. h. fremonti*. Therefore, we consider the name combination *Tamiasciurus hudsonicus wasatchensis* to be a synonym of the earlier proposed *Sciurus fremonti* Audubon and Bachman [*Tamiasciurus hudsonicus fremonti*].

Animals from Grand and San Juan counties in extreme southeastern Utah, east of the Colorado River are intergrades between *T. h. mogollonensis* and *T. h. fremonti*. In the size and outline of the skull, size of the tympanic bullae and width of the interpterygoid space, these southeastern animals resemble topotypes of *T. h. mogollonensis*. In all other cranial features they resemble *T. h. fremonti*. The available specimens make comparisons of color rather inconclusive. In summer pelage, these animals from southeastern Utah resemble specimens of *T. h. fremonti* from Colorado, while those in winter pelage resemble topotypes of *T. h. mogollonensis*. This is especially true in specimens from Clark Lake in the La Sal Mountains. This particular series was prepared in borax, which may have altered the color, since they do not resemble other animals from the same general area. The topotypes of *T. h. mogollonensis* from the United States National Museum may likewise have changed

color resulting from age or preparation. All things considered, we refer these animals from southeastern Utah to *T. h. fremonti*.

Specimens examined.—Total, 88, distributed as follows: *Utah County*: Tinnys Flat, Santaquin Canyon, 8,000 ft., 1; Nebo Scenic Road at Utah County line, 1 (WJC). *Summit County*: Henrys Fork, 8,300 ft., 1; Hoop Lake, 8,000 ft., Ashbury [Ashley] National Forest, Dagget [Summit], 1; Beaver Creek Ranger Station, 1 (BYU); Elk Lake, Norway Flat, 8,900 ft., 20 mi. NE Kamas, 1; Whitney Ranger Station, Bear River, 9,100 ft., 1 (USAC); Smith and Morehouse Creek, Weber River, 4; 12 mi. E Oakley, 7,500 ft., 2; Lost Lake, Uinta Mountains, 4 (BYU); Soapstone, 1; Provo River, Uinta Mountains, 1 (BYU); Tryol Lake, Uinta Mountains, 4 (BYU). *Daggett County*: Junction Deep and Carter creeks, 7,900 ft., 2; Elk Park, Uinta Mountains, 4 (BYU). *Wasatch County*: Strawberry Reservoir, 2 (USAC). *Duchesne County*: Mirror Lake, 10,500 ft., 2 (1, BYU); 2 mi. E Duchesne, 1; Head of Indian Canyon, 1. *Uintah County*: 9 mi. NW Paradise Park, 11,000 ft., Ashley National Forest, 1; Paradise Park, 10,100 ft., 6; Iron Springs, 9,000 ft., 6; Hacking Lake, 15 mi. due NW Vernal, 9,000 ft., 1. *Juab County*: Loop Road, E Mount Nebo, 9,340 ft., at Utah-Juab County line, 20; Nebo Scenic Loop Road, E Mount Nebo, 10,000 ft., Utah-Juab County line, 5 (WJC); Pole Canyon, 3 mi. E Mona, 8,000 ft., 2; Bear Canyon Picnic Grounds, SE Mount Nebo, 7,000 ft., 1. *Sanpete County*: 11 mi. E Fairview, 8,500 ft., 2 (WJC); Boulger Reservoir, 17 mi. E Fairview, 8,500 ft., 1; Skyline Drive, 12 mi. E Mt. Pleasant, 9,500 ft., 2; Ephraim Canyon, 15 mi. E Ephraim, 10,000 ft., 2; Skyline Drive, 17 mi. SE Ephraim, 1 (WJC); 5 mi. E Ferron Reservoir, 20 mi. W Ferron, 7,500 ft., 1; So. Fork, Manti Canyon, 1 (USAC); No. Fork, Manti Canyon, 1 (USAC). *Grand County*: Clark Lake, La Sal Mountains, 7 (3, BYU); La Sal Mountains, Mt. Tuhemnitzstz [Tomaski], 9,000 ft., 1 (BYU). *San Juan County*: 3 mi. W Geyser Pass, La Sal Mountains, 10,000 ft., 2; 1 mi. W Geyser Pass, La Sal Mountains, 11,000 ft., 1; Geyser Pass, La Sal Mountains, 1 (BYU); 1 mi. E Geyser Pass, La Sal Mountains, 9,700 ft., 1; Jackson Ridge, 25 mi. N Blanding, Abajo Mountains, 9,500 ft., 3; 1 mi. E Jackson Camp, 21 mi. N Blanding, Abajo Mountains, 10,200 ft., 2.

Tamiasciurus hudsonicus dixiensis Hardy

Tamiasciurus fremonti dixiensis Hardy, Proc. Biol. Soc. Washington, 55: 87, June 25, 1942, type from "near Further Water", Dixie National Forest, Pine Valley Mountains, 9,500 feet, Washington County, Utah.

Tamiasciurus hudsonicus dixiensis, Kelson, Univ. Utah Biol. Series, 11(3): 14, February 15, 1951.

Range.—Mountains of south central and southwestern Utah.

Remarks.—Typical representatives are characterized by: Upper parts near Raw Umber (general tone) owing to alternate banding of individual hairs of Isabella Color and black (bands vary from 5 to 9); top of head darker because of greater admixture of black; dorsal surface of tail mixed Isabella Color, black and white; hairs of tail tipped with white; lateral line generally black (tinted with Isabella Color in some specimens); skull long and robust; nasals long and extend posterior to frontopremaxillary suture; interpterygoid space lyre-shaped; alveolar length of upper molariform series long.

For comparisons with other subspecies known to occur in Utah, see accounts of those subspecies.

Critical analysis of the diagnostic characters of *T. h. dixiensis* indicates that it is a subspecies *in statu nascendi*, and is at present undergoing rapid differentiation. Animals from the Pine Valley Mountains, in extreme southwestern Utah are the most characteristic, but do retain some characters representative of *T. h. fremonti* to which they are undoubtedly closely allied. Although *T. h. dixiensis* is a poorly differentiated subspecies, we feel that differentiation has progressed far enough to merit recognition as a distinct subspecies, and that the taxonomic relationships and the evolutionary implications are better understood by so doing. All animals from elsewhere within the range ascribed to *T. h. dixiensis* are intergrades between it and *T. h. fremonti*. From the Pine Valley Mountains northward to Mount Nebo, the animals exhibit a progressively greater approach toward *T. h. fremonti*.

Specimens examined.—Total, 41, distributed as follows: *Beaver County*: Puffer Lake, 9,500 ft., 2 (1, WJC). *Wayne County*: Elkhorn G. S., 14 mi. N Torrey, Fishlake Plateau, 9,400 ft., 3; Donkey Lake, Boulder Mountain, 10,000 ft., 5; Boulder Mountain, 2 (BYU). *Iron County*: Parowan Canyon, 2 (1, BYU); Cedar Mountains, 8,500 ft., 3 (2, BYU); Cedar Breaks, 1 (BYU). *Garfield County*: 18 mi. N Escalante, 9,500 ft., 2; Cyclone Lake, Aquarius Plateau, 5 (BYU); 35 mi. E Cedar City, 1 (USAC). *Washington County*: "Near Further Water", Dixie National Forest, Pine Valley Mountains, 9,500 ft., 1; "near" Whipple Valley, 5 mi. E Pine Valley, 9,000 ft., 1; 1 mi. up Middle Fork from Pine Valley Camp of the Dixie National Forest, 1 (WJC). *Kane County*: Duck Creek, Cedar Mountains, 9,000 ft., 6; 2 mi. W Navajo Lake, 3 (USAC); Navajo Lake, 3 (2, BYU; 1, WJC).

LITERATURE CITED

ALLEN, J. A. 1877. Monograph of North American Rodentia, vol. XI; 631-939, Report of the U. S. Geological Survey of the Territories (Hayden), U. S. Government Printing Office, Washington, D. C., 1877.

——— 1898. Revision of the chickarees, or North American red squirrels (subgenus Tamiasciurus). Bul. American Mus. Nat. Hist., 10: 249-298, July 22, 1898.

DURRANT, S. D. 1952. Mammals of Utah, taxonomy and distribution. Univ. Kansas Publ. Mus. Nat. Hist., 6: 1-549, August 10, 1952.

HARDY, R. 1950. A new tree squirrel from central Utah. Proc. Biol. Soc. Washington, 63: 13-14, April 26, 1950.

KELSON, K. R. 1951. Speciation in rodents of the Colorado River drainage of eastern Utah. Univ. Utah Biol. Series, 11(3): 1-125, February 15, 1951.

RIDGWAY, R. 1912. Color standards and color nomenclature. Washington, D. C., Privately printed, iv plus 44 p.

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A NEW SUBSPECIES OF THE POCKET MOUSE (*PEROGNATHUS PARVUS*) FROM WASHINGTON

By HAROLD E. BROADBOOKS

During the summers of 1946 and 1947, I live-trapped forty-five pocket mice and took five others in snap traps while studying small mammal populations at Rocky Flat, sixteen miles northwest of Naches, Yakima County, Washington. This locality, also called Rocky Prairie, is about four miles east of U. S. Highway 410, on the Bald Mountain Road. These mice at Rocky Flat and other specimens from central and southern Washington appear to represent an unrecognized race.

Specimens were sent on loan from the United States Biological Survey Collection, University of California Museum of Vertebrate Zoology, Washington State Museum, and Patuxent Wildlife Research Refuge. I am indebted to Stanley P. Young, Seth B. Benson, Mrs. Martha Flahaut, William H. Stickel, and Hartley H. T. Jackson for permission to examine material in their care. I appreciate the generous help given by Dr. William H. Burt and Dr. Emmet T. Hooper. I also want to thank my wife, who did a large part of the statistical calculations.

All measurements of the skull were made with dial calipers accurate to one-tenth of a millimeter. Measurements of the interparietal were made with the

aid of a binocular microscope. As employed here, occipito-nasal length represents the distance from the tip of the nasals to the most posterior projection of the supraoccipital; width of skull, greatest width across mastoid bullae; length of mastoid bulla, greatest distance from its anterior to posterior end; length of auditory bulla, distance from anterior tip of bulla, where the two bullae meet at the midline, to posterior end; length of interparietal, distance on midline from its anterior tip to posterior edge; width of interparietal, greatest breadth; interorbital width, narrowest width between orbits.

I have recognized two age groups based on amount of wear of cheek teeth—specimens with slight or moderate wear are considered subadults; adults show considerable wear. Mice of comparable age in fresh pelage (usually fall specimens) were used for comparisons of color.

Adults apparently are not significantly different from subadults. When the undescribed race was compared with the three neighboring races, subadults differed significantly in some cases, and adults alone in others. For this reason I have not lumped measurements of the two age groups.

Males are larger than females in some dimensions. This was shown by tests of all of the specimens from central and southern Washington included in the range of the undescribed subspecies. The *t* test (Snedecor, Statistical Methods, 1946) showed that subadult males are significantly larger than subadult females in four measurements: occipito-nasal length, length of mastoid bulla, length of tail, and length of hind foot. Adults differ significantly in one measurement, the interorbital width; adult males have a greater width than adult females.

Perognathus parvus yakimensis, new subspecies

Type.—Young adult male, skin, skull, and baculum, University of Michigan Museum of Zoology No. 95978; Washington, Yakima County, sixteen miles NW Naches, Rocky Flat (or Rocky Prairie), 3800 feet elevation; taken August 27, 1947, by Harold E. Broadbooks; original number, 1042.

Distribution.—Central and south-central Washington between the Columbia River and the Cascade Mountains, from the vicinity of Ellensburg on the north to the Columbia River on the south, thence west along the Columbia River to the vicinity of Dallesport.

Characters.—Cranial features best distinguish the subspecies *yakimensis*. The small auditory bullae and relatively wide, short interparietal (Table 1) set this race apart from all three of the neighboring subspecies of *parvus* (*parvus*, *columbianus*, and *lordi*). The angle formed by the anterior border of the interparietal also is more obtuse in *yakimensis* than in the other races. Two subadult males from the type locality of *yakimensis* have angles of 144 and 148 degrees.

The dorsal color of *yakimensis* is not at all uniform. Specimens from northern Yakima Valley in the northern part of the range of the subspecies are darker than those from farther south. This is due to the relatively greater amount of black and less buff in the former. The characteristic color of the basal part of the dorsal hairs is deep neutral gray. Distally, there is a narrow band of ochraceous buff. The tips are black.

Comparisons.—Compared with *parvus*, the subspecies it most closely resembles, *yakimensis* has significantly shorter auditory bullae, a smaller interparietal ratio, and larger hind feet (Table 1). Specimens of *parvus* from the type locality, The Dalles, Oregon, may readily be distinguished from *yakimensis*, on the opposite bank of the Columbia River in Washington, by the shape of the interparietal. One typical subadult male *parvus* from The Dalles has an interparietal with an angle of 108 degrees. (The angle is about 146 degrees in

TABLE 1.—*Statistical data on four races of Perognathus parvus in Washington and Oregon*

MEASUREMENT	SEX AND AGE	YAKIMENSIS			PARVUS			COLUMBIANUS			LORDI		
		No.	Mean	Standard error	No.	Mean	Standard error	No.	Mean	Standard error	No	Mean	Standard error
Occipito-nasal length	♀ ad	8	25.15	.248	9	24.70	.253	5	24.86	.310	4	26.08	.132
	♀ subad	14	24.66	.120	9	24.76	.190	12	25.22	.207	8	25.59	.136
	♂ ad	12	25.56	.223	25	25.67	.141	10	26.01	.301	9	27.37	.189
	♂ subad	15	25.29	.211	9	25.24	.162	17	25.75	.155	8	26.06	.244
Skull width	♀ ad	8	12.92	.128	10	12.91	.104	6	13.65	.128	4	13.50	.123
	♀ subad	13	12.71	.072	9	13.06	.163	12	13.68	.293	8	13.31	.088
	♂ ad	11	13.03	.082	23	13.36	.062	11	13.85	.129	9	13.93	.147
	♂ subad	16	12.90	.059	10	12.96	.103	17	13.82	.083	10	13.49	.074
Mastoid bulla length	♀ ad	8	8.12	.131	9	8.26	.088	6	9.08	.062	5	8.78	.082
	♀ subad	13	7.92	.058	9	8.42	.140	11	8.97	.062	8	8.63	.092
	♂ ad	11	8.23	.096	21	8.54	.059	11	9.22	.089	10	9.03	.111
	♂ subad	16	8.17	.053	11	8.36	.096	17	9.16	.069	10	8.76	.109
Auditory bulla length	♀ ad	5	6.98	.097	8	7.20	.033	6	7.68	.040	3	7.63	.145
	♀ subad	8	6.94	.047	6	7.43	.062	8	7.66	.010	5	7.66	.068
	♂ ad	7	7.07	.075	18	7.41	.051	9	7.88	.113	8	8.01	.067
	♂ subad	10	6.96	.040	9	7.39	.059	11	7.78	.051	9	7.78	.079
Interparietal length	♀ ad	7	3.09	.103	11	3.30	.065	6	3.28	.174	5	3.16	.081
	♀ subad	11	3.05	.055	9	3.27	.108	12	3.21	.058	8	3.29	.061
	♂ ad	10	2.99	.061	22	3.44	.050	11	3.35	.080	10	3.34	.085
	♂ subad	14	3.11	.049	11	3.51	.069	16	3.28	.066	10	3.24	.060
Interparietal width	♀ ad	8	5.16	.068	11	4.90	.066	6	4.37	.088	5	4.70	.105
	♀ subad	14	5.20	.079	10	4.85	.143	12	4.52	.103	8	4.65	.115
	♂ ad	12	5.38	.096	24	5.09	.078	11	4.45	.097	10	4.84	.093
	♂ subad	14	5.25	.093	10	4.95	.097	16	4.63	.072	13	4.82	.078
Interparietal ratio, l/w × 100	♀ ad	8	59.25	1.827	10	65.75	1.348	6	75.00	2.731	5	67.26	1.241
	♀ subad	12	60.15	1.251	9	68.77	2.330	12	71.46	2.241	7	69.91	1.861
	♂ ad	10	57.01	1.520	23	67.74	1.197	11	75.53	1.191	11	68.64	1.526
	♂ subad	14	59.99	1.033	10	70.99	1.255	17	71.74	1.838	10	68.52	1.454
Interorbital width	♀ ad	8	5.60	.068	9	5.79	.083	6	5.63	.074	5	5.88	.066
	♀ subad	13	5.47	.036	9	5.60	.033	11	5.67	.036	8	5.86	.050
	♂ ad	12	5.85	.057	24	5.78	.055	11	5.67	.090	9	6.00	.065
	♂ subad	16	5.58	.049	10	5.78	.100	17	5.69	.042	10	5.88	.047
Total length	♀ ad	4	172.25	7.158	8	160.64	2.170	6	169.67	2.813	4	172.25	.958
	♀ subad	12	165.50	2.017	7	167.70	3.131	11	171.27	1.362	7	172.10	.195
	♂ ad	7	172.30	2.941	19	169.50	1.761	10	171.00	3.915	9	179.70	1.563
	♂ subad	12	168.30	2.862	8	166.10	3.303	18	180.50	1.721	10	176.40	1.392
Tail length	♀ ad	4	89.00	2.381	10	87.20	1.036	6	92.00	2.251	4	92.75	.947
	♀ subad	12	87.33	1.573	7	89.43	2.034	11	93.00	.934	7	93.86	2.282
	♂ ad	7	90.14	2.176	18	90.78	1.404	10	90.20	2.700	8	95.50	1.711
	♂ subad	12	89.33	1.689	8	88.38	1.511	18	99.56	1.178	10	93.00	5.079
Hind foot	♀ ad	4	22.50	.687	7	21.30	.469	6	22.33	.307	4	22.80	.169
	♀ subad	13	22.19	.318	7	20.79	.576	11	22.77	.227	7	22.29	.241
	♂ ad	7	22.86	.508	19	22.00	.254	11	22.97	.250	9	22.11	.200
	♂ subad	12	23.25	.272	9	22.00	.412	18	23.06	.127	10	23.11	.197

yakimensis.) *Parvus* from other parts of Oregon and southeastern Washington usually have more obtuse angles than those from the type locality, but still they are more acute than in *yakimensis*. Specimens from several localities in Walla Walla County in southeastern Washington resemble *parvus* rather than *yakimensis*; two subadult males from Wallula average 126 (114, 128) and one subadult male from Prescott measures 116 degrees. A skull of an adult female *parvus* from Baker, Oregon, looks very much like some Yakima Valley specimens; the angle of its interparietal is 135 degrees. I have measurements of two adult female *yakimensis* for comparison. One is from the type locality to the north and the other from Mabton to the south in Yakima Valley. Their angles are 138 and 140 degrees, respectively.

Measurements showing significant differences at the one per cent level are as follows: interparietal ratio and hind foot, both sexes; length of auditory bulla, all except female

adults; length of mastoid bulla, female subadults and male adults; length of interparietal, male adults and subadults; width of skull, male adults; and total length, female adults. Also, the following measurements were significant at the five per cent level: length of auditory bulla, female adults; width of interparietal, male adults and subadults; width of skull and interobital width, female subadults.

In general, specimens of *parvus* have more brown or buff dorsally and in the lateral stripes than do skins of *yakimensis*. The ear patches are whiter and less buffy in the latter. A specimen of *parvus* in fresh winter pelage (October 20), from 30 miles northwest of Burns, Oregon, looks much like four *yakimensis* topotypes with respect to its dark dorsal color and small ear patches.

Compared with *columbianus*, skulls of *yakimensis* are significantly narrower, the mastoid bullae and auditory bullae shorter, interparietals wider, and the interparietal ratio smaller (Table 1). The difference in the size of the auditory bullae is particularly apparent in these two races.

The *t* test revealed significant differences at the one per cent level in the following measurements: width of skull, length of mastoid bulla, length of auditory bulla, width of interparietal, and interparietal ratio, both sexes; length of interparietal, male adults; interorbital width, female subadults; total length, male subadults; tail length, subadults of both sexes. In addition, the following measurements were significant at the five per cent level: occipito-nasal length and total length, female subadults; length of interparietal, male subadults.

The angle formed by the anterior border of the interparietal is more obtuse in *yakimensis* than in *columbianus*. Eight subadult males of the latter race from Connell average 122 (117–128) degrees. (Two comparable topotypes of *yakimensis* average 146.) The angle between the auditory bullae also is more obtuse in *yakimensis*.

The dorsal color of *yakimensis* from the northern part of Yakima Valley is darker than that of *columbianus*. The cheeks also are darker and lack the buff of the latter. Skins from the lower Yakima Valley resemble *columbianus* closely, but usually the dorsal color is not so gray as in that race.

Compared with *lordi*, in addition to smaller auditory bullae, *yakimensis* has a significantly shorter and narrower skull, smaller mastoid bullae, and a wider interparietal (Table 1). The anterior border of the interparietal forms an angle of 121 degrees in a subadult male *lordi* from Vernon, British Columbia. The wedge-shaped space between the two auditory bullae also is more obtuse in the latter.

A statistical comparison of these two races revealed significant differences at the one per cent level in the following measurements: length of mastoid bulla, length of auditory bulla, width of interparietal, and interparietal ratio, both sexes; interorbital width, subadults of both sexes; occipito-nasal length and length of interparietal, female subadults and male adults; width of skull, all except female adults. In addition, the following measurements were significant at the five per cent level: occipito-nasal length, female adults and male subadults; total length, all except female adults; width of skull and interorbital width, female adults; tail length, female subadults.

Specimens of *yakimensis* from the northern end of Yakima Valley resemble *lordi* rather closely in dorsal coloration. Skins from the lower Yakima Valley and along the Columbia River to the south are paler; in this respect they resemble *columbianus* and *parvus* rather than *lordi*. The white spot at the base of the ear is somewhat less distinct in *yakimensis* than in *lordi*.

Remarks.—There appears to be no contact between the ranges of the subspecies *yakimensis* and *lordi*. The northernmost records of the former are Ellensburg and Vantage in Kittitas County, Washington. The nearest specimens of *lordi* are from Chelan, about 60 miles to the north. The wooded Wenatchee Mountains rise in this intervening area, but the lower ground along the west bank of the Columbia River between Vantage and Chelan may be a corridor that connects the two subspecies.

The Dalles, Oregon, was assumed by Osgood (N. Amer. Fauna No. 18, 1900: 34–36) to be the type locality of *P. p. parvus*. The type specimen is lost (Poole and Schantz, U. S. Nat.

Museum Bulletin 178, 1942: 574), so it is not possible to resolve the question of whether the type was collected on the north or the south side of the Columbia River.

Previous authors have limited the range of the subspecies *columbianus* to a restricted area in the immediate vicinity of Pasco, the type locality. It seems to me that the race probably occurs over the plains of the entire Big Bend region, an area bounded by the Snake and Columbia rivers on the south and by the Columbia on the west and north. The exact limits of range of this subspecies to the north and east are not clear to me. Unfortunately, I have seen but five specimens from extreme eastern Washington, from Asotin County in the southeastern corner of the state. These specimens resemble *lordi* in their dark, dorsal coloration. In length of skull and large mastoid and auditory bullae they resemble *lordi* or *columbianus* rather than *parvus*. Specimens identified as *lordi* have been recorded in the literature (Osgood, *op. cit.*) from Marcus (Stevens County) in northeastern Washington, from Spokane and vicinity, and farther south from Alamota, Whitman County, Washington, and from Lewiston, Idaho. Some of these records apparently were overlooked by Dalquest (Univ. Kansas Publ. Mus. of Nat. Hist. Vol. 2, 1948: 298), and should be added to his distribution map of pocket mice in Washington. Possibly the range of *lordi* may extend from northern and northeastern Washington south along the Idaho border to the Oregon line east of the Blue Mountains.

The subspecies *columbianus* and *lordi* apparently are closely related. The latter is darker on the average and differs somewhat from *columbianus* in certain measurements of the skull (Table 1). Width of skull across the mastoid bullae, length of mastoid bullae, and the ratio of length to width of the interparietal average larger in *columbianus*. The average occipito-nasal length is greater in *lordi*. A difference in proportions of the skulls is shown by the width/length ratio. Six subadult male *lordi* from Vernon, B. C., average 51.4 (50.0–53.2) while eight comparable *columbianus* from Connell average 53.7 (52.8–54.4). There apparently are no important differences between the two in external dimensions of total length, length of tail, and length of hind foot.

Some of the most distinct *columbianus* seem to be located near the center of the Big Bend region in the middle of the range of the subspecies. A larger series of mice from this area is required for adequate comparisons, but the few specimens from the vicinity of Moses Lake represent extremes in several of the distinguishing characters of the race. Thus, two subadult males have the largest mastoid bullae (9.6 and 9.8 mm.) and the widest skulls (14.4 and 14.6 mm.) of *columbianus* belonging to this age group. The highest length/width ratio of the interparietal, 92.1, is that of a subadult female from two miles south of Moses Lake.

Specimens examined.—Perognathus parvus yakimensis. Washington: Kittitas County, Ellensburg, 3. Yakima County, 16 miles northwest of Naches, Rocky Flat (Rocky Prairie), 5; Selah, 1; Yakima (North Yakima), 13; 10 miles west of Wiley City, 4; Sunnyside, 9; Mabton, 14. Klickitat County, Cliffs, 2; Grand Dalles (Dallesport), 2; Rockland (Dallesport), 6.

Perognathus parvus lordi. British Columbia: Kamloops, 1; Vernon, 9; Ashcroft, 5. Washington: Okanogan County, Okanogan, 19; Chelan County, Chelan, 2; Asotin County, Asotin, 2; 6 miles south of Anatone Grande Ronde River, 3.

Perognathus parvus columbianus. Washington: Douglas County, Waterville, 1; Wenatchee, east side of Columbia River, 5; Grant County, 2 miles southwest of Coulee Dam, Steamboat Rock, 2; Coulee City, 2; 2 miles south of Moses Lake (Neppel), 6; 11 miles south of Moses Lake, Crab Creek, 2; Franklin County, Connell, 18; Pasco, 7; 7 miles east of Connell, Sulphur Lake, 7; Lyon's Ferry, north side of Snake River (across the river from Perry), 1.

Perognathus parvus parvus. Washington: Walla Walla County, Prescott, 3; Touchet, 11; Wallula, 5. Oregon: Baker County, Baker, 1; Crook County, Prineville, 4; Gilliam County, Willows, 8; Harney County, Burns, 3; 30 miles northwest of Burns, 1; Denio, 1; Rock Creek Sink, 2; Lake County, Fremont, 1; Malheur County, Narrows, 1; Riverside, 3; Vale, 2; Morrow County, Heppner, 5; Umatilla County, Umatilla, 2; Wasco County, The Dalles, 11; Maupin, 1.

Radioisotope Unit, U. S. Veterans Hospital, Seattle, Washington. Received January 21, 1953.

GENERAL NOTES

NOTES ON MAMMALS FROM NORTHERN CHIAPAS, MEXICO

A small collection of mammals was prepared in the course of an ecological and parasitological study of vertebrates made in the Mexican state of Chiapas during the summer of 1949. All collecting was carried on in the immediate vicinity of the archeological zone of the Maya ruins which are situated about six miles southeast of the present village of Palenque in northeastern Chiapas. These ruins (elevation 210 meters) lie in the tropical rain forest that covers the northern foothills of the Sierra de Palenque. The region represents a portion of the Humid Lower Tropical Life Zone of southern Mexico, and is included in the Veracruz Biotic Province of Goldman and Moore (Jour. Mamm., 26: 347-360, 1945). The rainfall recorded at Palenque averages some 3200 mm. annually.

Nine of the forms in the following list do not appear to have been previously recorded from the state of Chiapas, and one of this number (*Ototylomys phyllotis guatemalae*) is apparently new to the Republic of Mexico. The new Chiapas records have been designated by an asterisk preceding the name.

In an effort to learn something of the approximate density of small mammal populations in the rain forest, a half-acre plot was saturated with 50 snap traps for a three day period. During that time a total of seven specimens (five mice, *Peromyscus mexicanus* and two rats, *Ototylomys phyllotis*) were secured.

For assistance in many ways we are indebted to Mr. Colin C. Sanborn, Chicago Natural History Museum, Dr. Clarence J. Goodnight and Mr. William T. Rockhold, Purdue University, Dr. David H. Johnson, U. S. National Museum, and Dr. Emmet T. Hooper and Mr. Luis de la Torre, University of Michigan Museum of Zoology. The bat flies were identified by Mr. R. L. Wenzel, Chicago Natural History Museum. This study was supported in part by a grant from the Purdue Research Foundation. All collected material has been deposited in the Chicago Natural History Museum.

A complete account of the helminth parasites of these mammals will be published at a later date. Only especially heavy infections have been reported here.

Measurements are given in millimeters.

ACCOUNTS OF SPECIES

* **Caluromys derbianus aztecus** (Thomas). White-eared woolly opossum.—One young adult male, July 30. Taken at night in deep forest while it was feeding some 50 feet above the ground. The specimen measured: total length, 705; tail, 430; hind foot, 46; ear, 36 mm.

Philander opossum pallidus (Allen). Four-eyed opossum.—One male, July 14. Secured at night from a cornfield (*milpa*) where it was feeding. Apparently common as the local inhabitants seemed rather familiar with this form.

Didelphis marsupialis Linnaeus. Black-eared opossum.—Seemingly quite common as several were killed by dogs in the vicinity. No skins were prepared.

Saccopteryx bilineata (Temminck). White-lined bat.—Two females taken on July 17 and 26 weighed 6.5 and 6.8 grams. One was captured while it was roosting in a subterranean passageway of a Maya ruin in the vicinity of some sac-winged bats (*Peropteryx macrotis*), and the other was found clinging to the partially shaded exterior of a ruin in the deep forest. The intestine of one specimen was infected with over a thousand trematodes.

* **Peropteryx macrotis macrotis** (Wagner). Sac-winged bat.—Two males, July 13 and 17, and five females (one immature), July 13 and 17. The immature weighed 4.5 grams, and the adults, 6.0, 6.0, 6.0, 6.0, 7.0, and 7.5 grams. This was the most common bat to be found in underground passageways of the ruins. The pelages were uniformly reddish brown except for two females whose upperparts were a dark blackish brown.

* **Pteronotus davyi fulvus** (Thomas). Naked-backed bat.—One sex ?, August 5. This specimen was obtained from the stomach of a Black and White Owl (*Ciccaba nigrolineata*). The bat was identified from its skull by Mr. Luis de la Torre.

* **Carollia perspicillata azteca** Saussure. Short-tailed bat.—Two males, July 21, and one female, July 19. They weighed 16.5, 16.5, and 17 grams. These bats were found only in the tunnel-like passageway of a small, stone bridge. The groups from which these specimens were taken numbered around 10 to 12 individuals. No other species of bats were observed to use this particular roosting cover.

* **Artibeus lituratus palmarum** Allen and Chapman. Trinidad fruit bat.—One specimen, a male, was taken on August 2 and weighed 70 grams. Fruit bats were repeatedly observed at twilight hovering about the Cecropia trees which bordered the forest edge. This specimen was shot only a few minutes after another fruit bat (*Artibeus jamaicensis*) had been secured from the same tree.

* **Artibeus jamaicensis yucatanicus** (Allen). Jamaica fruit bat.—One male taken on August 2 weighed 60 grams. Secured under the circumstances outlined for the preceding species. A bat fly (*Paratrichobius longicrus* Ribeiro) was removed from this specimen.

* **Desmodus rotundus murinus** Wagner. Vampire bat.—Three males taken on June 13 weighed 18.0, 19.5, and 21.0 grams. These are all probably young adults as Davis (Jour. Mamm., 25: 378, 1944) gives the weights of adults from southern Mexico (Hidalgo, Veracruz, and Guerrero) as ranging from 32 to 47 grams. He further states that on June 22 the young of the year (about one third grown) weighed 40 per cent as much as adults, and two weeks later 60 per cent as much. It appeared that these bats were limited to a restricted area within the extensive, subterranean passageways of a large ruin. A bat fly (*Trichobius parasiticus* Gervais) was taken from one of the specimens.

Myotis nigricans extremus Miller and Allen. Little black bat.—Two females taken on July 28 weighed 3.5 and 4.5 grams. One of several species of bats that utilized the underground passageways of the ruins as a roosting site. Both specimens were parasitized by trematodes; an estimated 300 worms representing at least three species were removed from the intestine of one of them.

Alouatta palliata mexicana Merriam. Black howler monkey.—One male, July 8. The characteristic roar of these monkeys was frequently heard throughout the day, especially during the morning hours. Post-mortem examination revealed the presence of thousands of pinworms in the caecum.

Ateles geoffroyi vellerosus (Gray). Mexican spider monkey. Three females (one juvenile and one young adult), August 5. All were secured from the same group. A band of 20 to 30 individuals was often seen traveling through the area in the early morning. The two adults were parasitized by filiarial worms in the body cavity, and large numbers of small roundworms in the caecum.

Sciurus aureogaster hypopyrrhus (Wagler). Fire-bellied squirrel.—Two males (one young adult), July 9 and August 7, and one female, August 7. The young adult weighed 343 grams, and the adults, 482 and 516 grams. The pair taken on August 7 were both melanistic, and the female was lactating. Seemingly uncommon, as the specimens taken were the only ones seen.

Sciurus deppei deppei Peters. Deppe's squirrel.—Four females (one young adult), July 7–August 5. The young adult weighed 192 grams, and the adults, 246, 292, and 301 grams. This appeared to be the most abundant squirrel. It might be expected that forms from this area should approach the race *vivax*. The pelage colors, however, compare most favorably with topotypes of *deppei* from Veracruz in the Chicago Natural History Museum.

Heteromys desmerestianus desmerestianus Gray. Spiny pocket mouse.—One male, July 7, and one female, July 21. They weighed 60 and 70 grams. The uterus contained three embryos. These mice were all trapped at the edge of a small stream. They measured: total length, 500, 307; tail, 154, 167 mm. Both specimens carried heavy infections of hookworms in the duodenum.

Tylomys nudicaudus nudicaudus (Peters). Climbing rat.—One young adult male taken on August 2 weighed 125 grams. It was captured in a large snap trap (baited with peanut butter) from a rocky ledge on a steep, heavily forested slope. Because of the size of these rats, we believe that adults may have been able to free themselves from the traps used. The

specimen measured: total length, 346; tail, 176; hind foot, 38; ear, 25.7 mm. Skull: condylobasal length, 39.3; interorbital width, 9.7; zygomatic width, 22.9; mastoid width, 16.8; palatal bridge, 7.9; upper toothrow, 9.3; width across m^1–m^2, 8.7 mm.

Since the Mexican species of this genus are poorly known, this specimen was referred to Dr. David H. Johnson who remarks (letter): "I believe that your specimen from Palenque, Chiapas, should be referred to *Tylomys nudicaudus*. It agrees fairly closely with one from Tuxtla Gutierrez, Chiapas, that was considered by Merriam to represent *nudicaudus* when he described *tumbalensis* and *bullaris* from the same general area. . . . Externally, your specimen is very similar to the type of *bullaris* in general dorsal coloration, sharply demarked white underparts, and white toes, but its skull lacks the strongly inflated bullae which served as the chief character in Merriam's diagnosis of *bullaris*. The skin of the type specimen of *tumbalensis* differs from that of your specimen in being darker, with a blackish dorsal streak, a buff-washed gray belly, and toes pigmented to the bases of the claws; but there is very little difference between the respective skulls except in age characters."

* **Ototylomys phyllotis guatemalae** Thomas. Lesser climbing rat.—Three males (two juveniles and one young adult), July 8–19, and also one adult female, July 12. The juveniles weighed 41 and 47 grams; the young adult, 120 grams; and the adult, 117 grams. The testes of the young adult were abdominal, and the female contained two embryos measuring 21.5 mm. from crown to rump. The young adults measured: total length, 319, 338; tail, 170, 182; hind foot, 27.8, 29.2; ear, 24.0, 25.1 mm. Skulls: mandible length, 40.0, 40.3; condylobasal length, 36.1, 36.1; basilar length of Hensel, 30.0, 30.6; orbital width, 6.0, 6.3; zygomatic width, 19.4, 19.5; mastoid width, 13.8, 14.3; length of nasals, 14.4, 14.5; upper toothrow, 6.9, 7.1 mm.

* **Peromyscus mexicanus teapensis** Osgood. Mexican white-footed mouse.—Eight males (two young adults and one immature), July 12–August 2, and three females (one young adult), July 5–13. The immature weighed 27 grams; the young adults, 33.5, 36, and 43.5 grams; and the adults, 37.5, 40.5, and 51 grams. The testes of the July 12 specimen were abdominal, and those of the July 13 mouse were scrotal. The female taken on July 5 was lactating. While these specimens are referred tentatively to *teapensis*, they are significantly smaller than the typical form according to Osgood (North Amer. Fauna, 28: 204, 1909), and show no evidence of the thickened rostrum. The following is a comparison of the average measurements of eight of our oldest specimens and ten of Osgood's adults (in brackets): total length, 223.8 (208–238), [245 (234–254)]; tail, 116.6 (107–129), [129 (121–126)]; hind foot, 25.3 (24–28), [28 (27–28.5)]; ear, 20.2 (18–22).

Cuniculus paca nelsoni (Goldman). Paca.—One female, July 7. No skin was prepared. Constantly hunted by the local inhabitants. Two additional pacas were killed by dogs during our stay in the area. The female examined on July 7 was found to be lactating.

Nasua narica narica (Linnaeus). Coati.—One juvenile male and five females (one young adult and three juveniles), July 23. This group probably represented a family unit, and was shot while feeding in a cornfield. Assigned to this race largely on the basis of range.

Potos flavus campechensis Nelson and Goldman. Kinkajou.—One young adult female, August 1. Commonly observed along the forest edge as they became active shortly before sundown. The red light reflected by the eyes of kinkajous was frequently sighted during night hunting. Although the skull measures somewhat smaller than the type of *campechensis*, the pelage color compares well with a specimen of *campechensis* in the Chicago Natural History Museum from British Honduras.

Eira barbara senex (Thomas). Tayra.—Two females (one young adult), July 29. These specimens were secured together in the heavy forest. The young adult shows less suffusion of brown and gray about the head. The right kidney contained a kidney worm (*Dioctophyme renale*) measuring about 10 inches in length.

Tagassu tajacu subspecies. Collared peccary.—Apparently roving bands were not uncommon as evidenced by numerous tracks and other signs both in the deep forest and cultivated areas. Although sighted on several occasions at a distance, none were secured.

A larger peccary, known to the local inhabitants as the *jabali*, reputedly inhabited the

higher slopes of the Sierra de Palenque. This would seem to be referrable to the white-lipped peccary (*Tagassu pecari*). This peccary, however, is usually considered to be a low-land species.—MERLE L. KUNS AND RICHARD E. TASHIAN, *Department of Biological Sciences, Purdue University, West Lafayette, Indiana; and Department of Biology, Long Island University, Brooklyn, New York.* *Received November 8, 1952.*

SOME SPEEDS OF SMALL MAMMALS

As there are relatively few records of the speeds attained by many of the common small mammals we attempted to time as accurately as possible 14 species obtained unharmed by live trapping or other means during the summer months of 1952. The results are tabulated in Table 1. All specimens were timed on the day of capture with the exception of *Pitymys*, *Microtus*, *Peromyscus maniculatus*, and *Napaeozapus*. These had been in captivity for periods up to several months but showed no lack of vigor. In general, an animal was tested only once. If the same individual was used more than once on the same day it was allowed sufficient rest between tests. On occasion, a specimen was run several consecutive times without rest in order to determine how rapidly it became fatigued. In such cases only the fastest rate is recorded. All speeds are considered to be near maximum, unless otherwise noted, since the animal was always frightened by shouts, clapping, or chasing when released. Trials were usually run in early evening to avoid any ill effects of hot sun. Acknowledgment is made to Kile Barbehenn who supplied several specimens and frequently aided in the tests.

The majority of the specimens were timed by releasing them at the center of a chalked circle and recording the time when they completely crossed the line. If the animal hesitated or did not run directly to the periphery of the circle the record was discarded. This method was not practicable in all cases. The jumping mice and opossum were released on a large lawn and timed between two points when they were running in a straight line, the distance being measured later. The *Blarina* was allowed to run along a wall when tested, since its path in the open was invariably tortuous. *Eptesicus* was timed while flying in a large laboratory. In addition, several untrapped red and gray squirrels were clocked on campus lawns. In all cases the time was recorded with a stop-watch to the nearest tenth of a second. Specimens smaller than chipmunks were run for 25 feet on an asphalt-gravel parking lot,

TABLE 1.—*Speeds of 14 species of mammals as determined by timing with a stop-watch over measured distances*

SPECIES	NO. TRIALS	FEET/SECOND MEAN AND EXTREMES
Didelphis v. virginiana	2	6.2 (6.1, 6.4)
Blarina brevicauda talpoides	2	2.7 (2.1, 3.3)
Eptesicus f. fuscus	7 (Consecutive)	15.7 (12.0–22.1)
Tamias striatus lysterii	8	11.2 (9.1–15.6)
Tamiasciurus hudsonicus loquax	2	12.5 (11.8, 13.3)
Sciurus carolinensis leucotis	6	19.0 (13.3–25.0)
" " "	1 (Cruising)	4.8
Peromyscus maniculatus gracilis	2	6.4 (6.2, 6.6)
Peromyscus m. bairdii	2	8.0 (7.8, 8.3)
Peromyscus leucopus noveboracensis	2	8.4 (6.9, 10.0)
Clethrionomys g. gapperi	2	6.1 (6.0, 6.2)
Microtus p. pennsylvanicus	3	8.0 (7.1–9.6)
Pitymys pinetorum scalopsoides	3	5.3 (4.2–6.2)
Mus musculus	1	11.9
Zapus h. hudsonius	1	8.1
Napaeozapus i. insignis	1	7.8

while the chipmunks, red, and gray squirrels were timed for 50 feet on the same surface or for varying distances on short grass.

The gray squirrel was the fastest species timed. One individual ran 25 feet per second, or approximately 17 miles per hour, while the average of six specimens was 19 feet per second. A foraging individual in the wild was timed at 4.8 feet per second, indicating that maximum speed is considerably above the normal "cruising" rate. *Blarina* was the slowest tested, one individual averaging 2.7 feet per second, or only about 1.8 miles per hour. As expected, the more fossorial species such as *Pitymys* are slower than those active mostly on the surface, such a *Microtus* and *Clethrionomys*. Woodland forms may also be slower than similar types living in more open habitats, judging from the performances of *Microtus* and *Clethrionomys* and the subspecies *Peromyscus maniculatus gracilis* and *P. m. bairdii*. The jumping mice were difficult to time accurately because of their erratic jumps and habit of stopping abruptly and remaining motionless. The *Zapus* tested had lost at least half its tail in the trap, and when first released had no control over its leaps or direction. After several trials, however, it recovered its balance and could then make about the same speed as an uninjured *Napaeozapus*.

The limited endurance of some small mammals was demonstrated by a pine mouse that was run five times over the 25 foot course without rest. Its speed dropped from 6.2 to 3.2 feet per second. It died the following day, possibly from its previous exertion.—JAMES N. LAYNE AND ALLEN H. BENTON, *Department of Conservation, Cornell University, Ithaca, New York, and Department of Biology, New York State College for Teachers, Albany.* *Received January 15, 1953.*

THE ROLE OF ICE IN THE DISTRIBUTION OF MAMMALS

When the history and distribution of insular mammals, or forms separated by straits, are being studied, the possibility of seasonal ice formation is frequently neglected. Ice formation requires prolonged periods with freezing temperatures. Since the major land masses lie in the Northern Hemisphere, this factor is important in the Arctic and North Temperate Zones. This paper is limited to a discussion of the effects of the seasonal freezing of bodies of water upon mammalian distribution. The barrier effect of glaciation is beyond the scope of this paper.

The role that ice plays in the distribution of mammals is twofold. Firstly, ice aids the distribution of many species. It operates in a static state, providing an avenue of distribution for terrestrial mammals. As a dynamic force it distributes certain species, transporting them on ocean currents. These movements of mammals upon the ice are regular seasonal movements, or sporadic incursions. Secondly, ice counteracts the barrier effect of water, thereby hindering the differentiation of terrestrial mammals isolated by water barriers.

Let us examine some observations of mammals using ice in their travels. The barren-ground caribou (*Rangifer arcticus*) uses frozen lakes, rivers, and straits during its migrations. In former years large herds crossed the frozen straits between the North American continent and the nearer Arctic Islands during spring and autumn migrations to and from fawning grounds. Preble (1908) outlined these movements and cited many observations of caribou crossing to Victoria, Banks, King William, Somerset, and Baffin islands. Preble considered that all the caribou retreated to the mainland in winter. It is now known that there were resident populations upon these islands. Grant (1902) reported caribou on Salisbury Island and considered that their establishment there was due to immigration from Baffin Island across the separating frozen strait.

Based on these observations it may be assumed that these islands along with Southampton and Coats islands were colonized by the immigration of barren-ground caribou from the mainland across frozen straits. The Arctic islands beyond Lancaster Sound and Viscount Melville Sound have probably been colonized by Peary's caribou (*Rangifer pearyi*) in the same way. Wollebaek (1926) reported a similar movement of reindeer between Arctic Asia and the islands to the north.

The caribou of western Baffin Island migrate north along the coast in the autumn. Man-

ning (1943) speculated that this movement might retrace the ancestral route of immigration from Melville Peninsula across Fury and Hecla Strait.

The muskox (*Ovibos moschatus*) is another mammal which is widely distributed in the American Arctic Archipelago. Its former distribution on many of the islands was undoubtedly effected by migration across frozen straits. Greely (1888) considered that the existence of muskoxen on northern Ellesmere Island resulted from migrations from the American continent north over adjacent islands. He believed that Smith Sound was crossed on their wanderings from Ellesmere Island to Greenland. Indeed there are indications that such an immigration to northwestern Greenland occurred during the exploratory period.

Writing of the moose (*Alces a. americana*) of Isle Royale, Lake Superior, Murie (1934) wrote: "The last influx of moose occurred during the winter of 1912-13. That winter was so cold that the water between the island and the mainland to the north froze over. The presence of moose on the island the following summer is correlated with conditions the previous winter, and it is presumed that a few moose crossed over on the ice. Since 1913, the moose has increased in numbers until now it is very abundant."

Two Arctic terrestrial carnivores, the wolf (*Canis lupus*) and Arctic fox (*Alopex lagopus*) range widely on shore ice and frozen straits. The foxes follow polar bears (*Thalarctos maritimus*) as scavengers. Stefansson (1921) reported observing wolves on the drifting ice off the Alaskan coast.

The migration of Arctic foxes across frozen straits has been studied by Elton (1949). He cited the observations of Nansen who saw fox tracks on the polar ice 150 miles north of Franz Josef Land; and of McClintock who observed a blue fox in March, 1858, on the winter ice of Baffin Bay about 130 miles from Greenland. After studying the changes in the blue: white fox ratio at Arctic posts for different years, Elton concluded: "At present we are aware of a chain of circumstantial evidence that points to a not negligible exchange between the Arctic fox populations of northwest and west Greenland, and Ellesmere, and Baffin Islands."

These observations indicate the distances these large cursorial mammals can travel before succumbing, but they hardly prepare us for the treks of certain reindeer recorded by Wollebaek (*op. cit.*). Marked reindeer have been shot on Spitsbergen which had apparently crossed the frozen seas from Nova Zemlya. He gives the distances between islands along the probable route as: Nova Zemlya to Franz Josef Land—380 kilometers, Franz Josef Land to Kong Karls Land—340 kilometers, Kong Karls Land to Edge Oy (Spitsbergen)—90 kilometers. Reindeer are also known to cross from the New Siberian Islands to Bennet Island, a distance of 125 kilometers.

Lemmings (genera *Lemmus* and *Dicrostonyx*) also wander over frozen lakes and the coastal shore ice. This movement is pronounced in the autumn when the animals are looking for sites for winter habitation. I observed several carcasses of *Dicrostonyx* on the ice about a mile off shore from Churchill, Manitoba, during May, 1948, while I was watching offshore migrating caribou herds. Seton (1911) remarked on how plentiful lemmings were on the islands of large tundra lakes, because of the lack of lesser predators. Such migrations are probably increased under the pressure of an expanding population. Coastal islands probably have been colonized by immigration from the mainland.

The role of ice in providing an avenue is a seasonal one. The hibernation of certain mammals prevents them from using winter ice to cross water barriers. The thirteen-lined ground squirrel (*Citellus tridecemlineatus*) is a common mammal in southeastern Michigan, but is absent from southwestern Ontario across the Detroit River. The opossum (*Didelphis virginiana*), however, has recently reappeared in southwestern Ontario (Wood, 1947), having probably crossed the Detroit River in winter. Similarly in Banff National Park, Alberta, a section of the Bow River separates two species of chipmunks (*Eutamias amoenus luteiventris* and *Eutamias minimus borealis*) according to Cowan (1946).

These examples have illustrated the use of ice by terrestrial mammals. Northern aquatic mammals such as the hair seals and polar bears take advantage of drifting ice for their own wanderings. Harp seals (*Phoca groenlandica*) and hooded seals (*Cystophora cristata*)

bear their young on the ice in the Labrador current. The current frequently forces ice floes through the Straits of Belle Isle and into the Gulf of St. Lawrence. These floes may drift as far as Cape Breton Island and provide sealing for the fishermen of the North Cape. There are several extra-limital records of seals for Nova Scotia and New Jersey. These seals were undoubtedly carried southward on ice floes (Anderson, 1946).

The same floes occasionally carry polar bears and Arctic foxes to the north shore of the Gulf of St. Lawrence. There are two unusual records of Arctic foxes on Cape Breton Island (Anderson, 1946; Cameron, 1950). These animals were carried by the same ice floes that occasionally bring harp and hooded seal pups to the shore of North Cape.

Polar bears are erratic but regular spring and summer visitors to the shores and islands of James Bay, and the southern shores of Hudson Bay. Their appearance is similarly best explained by transportation on the ice floes drifting down the western side of Hudson Bay.

Let us turn to the second role of ice; that of weakening the barrier effect of water, and hindering differentiation. We must examine the taxonomy of the same species that use ice in their migrations.

Jacobi (1931) in revising the genus *Rangifer*, placed the barren-ground caribou and reindeer into two species groups: *tarandus* of northern Europe and Asia west of the Ural Mountains, and *arcticus* of eastern Asia and North America. It is to be noted that the barrier between the species is a land one.

Peterson (1952) reviewing the genus *Alces*, classified the American forms as belonging to the holarctic species *alces*. He remarked on the close relationship of the subspecies *gigas* of Alaska to *pfizenmayeri* of Siberia.

Goldman (1944) classified American timber wolves as members of the holarctic species *Canis lupus*. He reported greater similarities between the wolves of Alaska and eastern Siberia than between many other American populations. In all these examples, the Bering Strait has acted as a weakened barrier. Differentiation on each side of the strait has been limited to the subspecific level. Barriers between species have been continental.

From the observed movements of such mammals as caribou, moose, muskox, wolf, arctic fox, polar bear, and lemmings on ice it may be concluded that their present wide Arctic and Subarctic distribution has probably been effected by winter migration across frozen straits.

Conclusions.—In order to illustrate the role of ice in their distribution, a number of mammals were chosen which have been observed to travel widely upon frozen lakes and seas. It has been found that many of these mammals have characteristics in common. They belong to holarctic species. The Asian and North American forms have differentiated only to a slight degree. Most of the genera are known only from Pleistocene deposits and Recent times (Simpson, 1945). All the evidence presented indicates recent and possibly repeated immigration across the Bering Strait when frozen "ice bridges" were available.

The above examples have illustrated the actions of populations, but we have also to consider the accidental transportation of individuals upon ice such as the Arctic foxes on Cape Breton Island. Where the new landfall is outside the environmental tolerances of the species, this accidental transportation is of no significance to the species range. Migration or accidental transportation to a suitable habitat, such as the migration of lemmings to coastal islands, leads to an expansion of the species range.

LITERATURE CITED

Anderson, R. M. 1946. Catalogue of Canadian recent mammals. Nat. Mus. Can., Bul. No. 102, 238 p.

Cameron, A. W. 1950. Arctic fox on Cape Breton Island. Can. Field-Nat., 64: 154. (Mislabeled 65 (4)).

Cowan, I. McT. 1946. Notes on the distribution of the chipmunks (*Eutamias*) in southern British Columbia and the Rocky Mountain region of southern Alberta with descriptions of two new races. Proc. Biol. Soc. Wash., 59: 107–118.

Elton, C. 1949. Movements of Arctic fox populations in the region of Baffin Bay and Smith Sound. Polar Record, Nos. 37, 38: 296–305.

Goldman, E. A. 1944. The wolves of North America. Amer. Wildlife Instit., Washington, 389–632.
Grant, M. 1902. The caribou. 7th Ann. Rept. New York Zool. Soc.: 175–196.
Greely, A. W. 1888. Report on the proceedings of the U. S. expedition to Lady Franklin Bay, Grinnell Land, Washington, 2: 6.
Jacobi, A. 1931. Das Rentier, eine zoologische Monographie der Gattung *Rangifer*. Zool. Anz. Erganzungsband zu band, 96. Leipzig, 264 p.
Manning, T. H. 1943. Notes on the mammals of south and central west Baffin Island. Jour. Mamm., 24: 47–59.
Murie, A. 1934. The moose of Isle Royale. Univ. Mich. Misc. Publ., No. 25, 44 p.
Peterson, R. L. 1952. A review of the living representatives of the genus *Alces*. Contrib. Roy. Ont. Mus. Zool. Paleo., No. 34. 30 p.
Preble, E. A. 1908. A biological investigation of the Athabaska-Mackenzie region N. Amer. Fauna, No. 27. 574 p.
Seton, E. T. 1911. The Arctic prairies. Internat. Univ. Press, New York. 308 p.
Simpson, G. G. 1945. The principles of classification and a classification of mammals. Bul. Amer. Mus. Nat. Hist., Vol. 85. 350 p.
Stefansson, V. 1921. The friendly Arctic, the story of five years in the polar regions. Macmillan Co., New York, 784 p.
Wollebaek, A. 1926. The Spitsbergen reindeer *Rangifer tarandus spetsbergensis*. Resultater av de Norske Statsundersløttede Spitsbergenekspeditioner. Bind. 1, Nr. 4, Oslo, 71 p.
Wood, A. A. 1947. An opossum in Kent County, Ontario. Can. Field-Nat., 61: 199.

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QUANTITATIVE EXPERIMENTS ON THE FOOD CONSUMPTION OF *PARASCALOPS BREWERI*

The voracious appetites of small insectivorous mammals have been a source of interest and amazement to naturalists for many years. Largely because of their need for a copious and continual food supply, such small insectivores as shrews and moles are generally difficult to keep in the laboratory, and as a result many of their behaviorisms are little known. Hisaw (1923), Christian (1950), and others have succeeded in keeping moles for various periods of time on artificial diets consisting of meat scraps, mouse carcasses, etc., but few have worked with more natural diets, probably because of the prodigious amounts of time and effort required in gathering natural foods. The following is an account of quantitative feeding experiments conducted on three adult specimens of the hairy-tailed mole, *Parascalops breweri*, which were sustained on a diet consisting exclusively of earthworms.

During the spring of 1951 the three moles were captured by the author on the campus of the University of Massachusetts, Amherst, Massachusetts. At the time of capture, each individual was weighed on a laboratory balance to the nearest gram and was placed in a separate metal pail containing six inches of fresh, moist topsoil which had been firmly packed beforehand. Each pail was eleven inches in diameter and nine inches deep, having a ¼-inch mesh wire cover to prevent the captive's escape. The pails were kept on the concrete basement floor of the Massachusetts Cooperative Wildlife Research Unit laboratory, where the temperature remained between 60 to 70 degrees Fahrenheit. The humidity was variable, but at no time did the soil in the pails dry to a depth greater than one-half inch. Large earthworms (presumably *Lumbricus terrestris*), known locally as "night crawlers", were the only foods introduced into the cages during the experiments. A constant effort was made to keep an ample supply available to the moles, in order to allow maximum consumption per unit of time. A new supply of worms was introduced about once every twelve hours. The worms were carefully washed free of excess soil, and their weight to the nearest 0.1 gram was recorded before they were placed in the cages. At intervals of twelve to thirty hours, each mole's pail was throughly cleaned, the contents sifted completely,

TABLE 1.—*Quantities of earthworms consumed by three captive hairy-tailed moles (Parascalops breweri)*

MOLE	SEX	DAYS (24 HR.)	QUANTITY EATEN (GRAMS)	
			Total	Per day
1	F	5.81	923	158.9
2	F	1.45	192	132.4
3	M	4.93	576	116.8
Totals		12.9	1691	138.8

and the remaining worms and fragments washed, weighed, and discarded. The pails were then refilled with fresh soil.

The quantities of earthworms consumed are shown in Table 1. The three moles weighed 41, 49, and 45 grams, respectively, or an average of 45 grams each. Thus the average daily consumption of earthworms was equal to more than 300 per cent of the body weight. This is even more astonishing if it may be assumed that their movements were restricted by the small size of the cages, the consequent expenditure of energy being less than under natural conditions. Also, if availability of food affects the activity, then these three moles were probably as inactive as they could possibly be. Activity was recorded at intervals on the basis of sight and sound observations, and the animals were found to be moving about from noon to 4:00 a.m. the following morning. The intervening eight hours were apparently spent in sleep. During the active period they rested for five to twenty minutes at a time at irregular intervals.

Hisaw (1923) reported that some specimens of *Scalopus* ate food equivalent to only 32 per cent of their body weight daily, while Christian (1950) gave 50 to 55 per cent for *Scalopus*. Brooks (1908), Piet (1917), and Dalquest and Orcutt (1942) reported 132, 133, and 140 per cent for *Parascalops*, *Talpa*, and *Neürotrichus*, respectively. The results of these other workers indicate a considerably smaller appetite, and it is evident that moles can be successfully maintained on less food than the three reported here. However, the quality of the food may have an important influence on the quantity. It is noteworthy that the three highest percentages given were attained with an earthworm or insect-earthworm diet, while the remainder were meat diets. A comparison of the basic ingredients of earthworms and common grade beef loin reveals that meat is far superior to earthworms in terms of calories per gram (1.419 calories for beef loin and 0.685 for earthworms). In fact it would be expected on the basis of these figures that the quantity of mammalian flesh needed to meet daily nutritional requirements would be less than half the quantity of earthworms required to do the same job. Common grade beef loin, incidentally, had the lowest nutrient values listed in the charts referred to (Anon., 1942).

During the experimental period, mole No. 3 gained six grams in body weight. No comparative weights were obtained for the other two. Two attempts were made to induce these animals to eat the carcasses of freshly killed laboratory mice, but no interest was taken in such foods while the worm supply was ample. The attitude towards the mice was one of dislike, every effort being taken to avoid them, and in one instance a mouse carcass was pushed aside and covered with soil. Freshly removed mouse brains and liver were definitely not acceptable when held either with the fingers or forceps. Fresh earth-worms, however, were taken readily from the author's hand.

LITERATURE CITED

ANONYMOUS. 1942. Nutritional Charts. Pittsburg: H. J. Heinz Co. Ed. 11. 44 p.

BROOKS, F. E. 1908. Notes on the habits of mice, moles, and shrews. West. Va. Univ. Agric. Exper. Sta. Bul. 113: 116–123.

CHRISTIAN, J. J. 1950. Behavior of the mole (*Scalopus*) and the shrew (*Blarina*). Jour. Mamm., 31: 281–287.

DALQUEST, W. W. AND D. R. ORCUTT. 1942. The biology of the least shrew mole, *Neŭrotrichus gibbsii minor*. Amer. Midl. Nat., 27: 387–401.

HISAW, F. L. 1923. Feeding habits of moles. Jour. Mamm., 4: 9–20.

PEIT, FRANCES. 1917. Some notes and observations on the mole in captivity. Scot. Nat., 69: 207–231.

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Received February 18, 1953.

NOTES ON A LITTER OF YOUNG MASKED SHREWS

On May 11, 1952 the young sons of Dr. Henry Van der Schalie of the Museum of Zoology found a nest of young *Sorex cinereus leseuri* under an old wooden door lying flat on the dense grass cover of a vacant lot in the suburbs of Ann Arbor, Michigan. The nest was a sphere of dried grass, fitted into a cavity in the soil about 2½ x 4 inches in size. The nest was ringed by a ridge of bits of soil and old scraps of dead and blackened vegetation, apparently the dump from the excavation of the nest cavity. The nest and young were carried home by the boys, and later returned and replaced under the door. I was not able to visit the nest until May 14, at which time the young were still in the nest and a large *Sorex* was flushed from it. I removed nest and young to the Museum of Zoology and put all into a glass aquarium. Later efforts to capture the female were unsuccessful. By the afternoon of May 14 there was a new, partially constructed nest about six inches from the site of the old one. The new nest was on top of the dead and blanched grass stems and was shaped like a partially constructed birds nest.

The young, of which there were seven, were fed at first on meal worm viscera soaked in water. Each day the meal worms were "diluted" increasingly with canned dog food until finally the young shrews were eating pure dog food, with only occasional meal worms. The amorphous nature of the food was instrumental in preventing fighting over scraps.

The young shrews were markedly repelled by bright light. They only rarely attempted to leave the nest, although they weighed as much as adults (3.4, 3.3, 3.2, 3.2, 3.0, 3.0, 2.9 grams). When they did leave the nest they appeared shaky and uncertain of themselves. No fecal deposition was noted in the nest, but always outside in a particular corner of the aquarium, with urination at the same time. The feces were semi-solid and a dark, intense green.

They soon became more venturesome and spent more time outside the nest. They scratched themselves constantly and frequently would attempt to scratch with one hind foot at the same time that the front feet were holding down a worm. This usually resulted in their collapsing and rolling over, still scratching themselves and worrying the worm. When eating they seemed oblivious to everything else, and would sometimes worry a worm so violently that they would lose their balance and fall over, search frantically for the worm and go to work on it again.

On May 19 their feces changed from green to the normal dark blackish-brown and became more solid. They now showed a rather negative reaction to the proximity of one of their sibs. Previously they had shown a tendency to huddle even while eating.

By May 22 they seemed to have a better sense of balance than before. They did not feed as frantically as before, but still rolled over, possibly intentionally, when grooming or scratching themselves. When I put a block of sod into the aquarium I heard for the first time the characteristic shrew twitter. Later in the afternoon after the block was riddled by them this note was no longer heard. I observed them climbing up on grass stems as far as their weight would allow, and then swinging by one hind foot, using the tail as a balancing organ. By this date they frequently assumed the characteristic "hunched up" appearance of shrews that is so seldom correctly portrayed by animal artists. Their ears were quite prominent. When they were foraging or moving slowly the tail was extended behind or dragged on the ground, but when they were excited or very active the tip of the tail was curved up and the tail carried up from the ground.

Their activity seemed influenced by the activity of others. When one started to eat from the dish another frequently joined him, or when one started to run around with his

nose in the air, sniffing, several others soon joined him and soon all were scurrying around with their noses in the air.

After May 26 pressure of other duties prevented me from giving them the constant attention I had been giving them. One was killed and eaten by his fellows on May 27, one each on May 29, 30 and 31, and two on June 1. At the present writing the remaining individual is still living in the care of Mr. R. S. Butsch of the Museum of Zoology.—William O. Pruitt, Jr., *Museum of Zoology, University of Michigan, Ann Arbor.* *Received November 15, 1952.* *(Current address: Arctic Aeromedical Laboratory, Ladd AFB, Fairbanks, Alaska)*

RECORDS OF THE SHORT-TAILED SHREW AND LEAST SHREW FROM COLORADO

Two short-tailed shrews, *Blarina brevicauda carolinensis* (Bachman), and two least shrews, *Cryptotis parva parva* (Say), were trapped by the authors, members of a University of Kansas Museum of Natural History field party, along the North Fork of the Republican River, one mile east of Laird, Yuma County, Colorado, on November 2, 1952. These were taken in museum special traps set on a dry, sandy substrate in a relatively thick cover of dry grasses. The traps were baited with dry oatmeal. The two *Blarina*, a male (KU 51573) and female (KU 51574), were both trapped in runs approximately ten yards from the west bank of the river. They constitute the first record of occurrence of the species in Colorado and measure, respectively: total length, 104 mm., 102; length of tail vertebrae, 24, 21; length of hind foot, 15, 14.

A single specimen of *Cryptotis parva* has been reported from Colorado (Warren, THE MAMMALS OF COLORADO, 1942, p. 13). This was obtained at Dry Willow Creek, also in Yuma County. Our two specimens, a male (KU 51589) and female (KU 51588), were trapped in random sets, and measure, respectively: total length, 81 mm., 85; length of tail vertebrae, 18, 18; length of hind foot, 11, 11.

Other mammals trapped one mile east of Laird include: *Reithrodontomys megalotis dychei* Allen, *Peromyscus maniculatus nebracensis* (Coues), *Microtus ochrogaster haydeni* (Baird), and *Mus musculus* subsp.—J. Knox Jones, Jr. and Richard B. Loomis, *Museum of Natural History, University of Kansas, Lawrence.* *Received December 4, 1952.*

NOTIOSOREX CRAWFORDI AND *ANTROZOUS PALLIDUS* FROM SOUTHEASTERN COLORADO

On the morning of May 19, 1950, the writer collected many bones from weathered pellets beneath a roost of the great horned owl (*Bubo virginianus*) three miles northwest of Higbee (N 37° 47′, 103° 28′ W), elevation 4300 feet, Otero County, Colorado. Among the bones that were later identified was a skull of the desert shrew (*Notiosorex crawfordi*) with complete upper dentition but lacking the braincase. Previous records of this poorly known shrew are widely scattered in the southwestern United States and Mexico. This specimen represents, to my knowledge, the northernmost occurrence of *Notiosorex* and the first record for Colorado. The locality is about 250 miles northwest of the nearest previously reported locality, Tula Canyon, Texas (Davis, Jour. Mamm., 22: 319, 1941).

Measurements of the skull of *Notiosorex* (KU 51673) from Colorado are: palatal length, 6.9 mm.; maxillary breadth, 4.9 mm.; least interorbital breadth, 4.0 mm.; length of maxillary tooth-row from front of first unicuspid, 6.1 mm.

The owl roost was in a vertical fissure in the face of a low sandstone cliff (Dakota Formation). Scattered junipers (*Juniperus monosperma*) grow on the rim of the upland, and skunkbush (*Rhus trilobata*) along the base of the rimrock. Other common plants in the area are soapweed (*Yucca glauca*), fourwing saltbush (*Atriplex canescens*), snakeweed (*Gutierrezia*), and blue grama grass (*Bouteloua gracilis*). Tree cactus (*Opuntia arborescens*) grows abundantly on gravelly soils of alluvial fans bordering the valley bottom one to three miles east of the owl roost.

Davis (Jour. Mamm., 22: 320) reported in 1941 the finding by Stager of specimens of *Notiosorex* in wood rat houses of *Neotoma micropus* in Texas. I tore apart and studied six

dens of *N. albigula warreni* in clumps of tree cactus, juniper, and skunkbush within three miles of the owl roost, but I saw no shrews, and none was caught in traps set at 22 dens in the same area.

Other kinds and numbers of small animals identified from bones below the owl roost are: 6 *Reithrodontomys*, 5 *Neotoma albigula* and *mexicana*, 4 *Cratogeomys castanops*, 4 *Perognathus flavus*, 3 *Perognathus hispidus*, 3 *Dipodomys ordii*, 1 *Rattus norvegicus*, 1 *Lepus*, 1 *Sylvilagus*, 1 *Cynomys ludovicianus*, 1 *Onychomys leucogaster*, 1 *Peromyscus maniculatus*, and 1 *Antrozous pallidus*.

The single skull of the pallid bat (*Antrozous pallidus*) appears not to have come from a weathered owl pellet. Perhaps the bat roosted in crevices of the same rocks as the owl. The skull (KU 51674) is of an adult. The alveolar length of the maxillary tooth-row measures 6.7 mm., which agrees with that of *A. p. pallidus* and is smaller than that of *A. bunkeri*. This occurrence of *Antrozous* falls nearly half-way between the closest previously reported localities of *A. pallidus* and *A. bunkeri*. *A. p. pallidus* was reported from Pueblo, Colorado, by Coues and Yarrow in 1876; and *A. bunkeri* was reported from three miles north of Kenton, Oklahoma (near the tip of the panhandle), by Burt in 1945 (Jour. Mamm., 26: 309). Probably both species of *Antrozous* occur at some localities in southeastern Colorado. —ROBERT B. FINLEY, JR., *Museum of Natural History, University of Kansas, Lawrence.* *Received December 31, 1952.*

VARIATION IN A COLONY OF LITTLE BROWN BATS

When one of the older dwellings on the Huntington Forest, near Newcomb, New York, was torn down in July, 1949, it was gassed before dismantling to kill the bats and other animals occupying the building. The 532 bats (*Myotis lucifugus lucifugus*) used in this study were collected the following morning when the roof was removed. All were freshly killed.

These animals were loosely distributed between the roof boards and the ceiling. The greatest number were found near the ridge and close to the rafters. There were no large clusters of bats. Each individual had room to move without annoying the others. Young bats, of various ages, were quite evenly distributed among the adult females. The number collected was estimated to be about one-half of the colony.

Large numbers of bats had occupied the building for many years. A large quantity of excrement had accumulated which literally filled the entire space between the roof boards and the ceiling for more than half the distance from the eaves to the ridge.

The purpose of this study is fourfold. 1. To show the variation in a single colony at a single time. 2. To show the sex ratios. 3. To determine the age composition. 4. To secure information on the date of birth, and subsequent growth and development.

The specimens were accurately measured in the laboratory where light conditions were constant and the treatment could be uniform. The same technique was applied to each specimen by the same individual to minimize errors. Each specimen was sexed and examined closely for color and coat condition. The length of the forearm was measured with calipers accurate to one-tenth of a millimeter. The age was recorded as immature or adult, depending upon the size, color, and the length and density of the fur. The skulls were then removed, numbered and put away for future study, and the rest of the carcass discarded.

Only 121 of the 532 specimens were males. This gives the sex ratio of the colony 29.4 males per 100 females. Further examination revealed that all of the males were the young of the year. There were 114 immature females, therefore the sex ratio for the young of the year was 106 males per 100 females.

The ratio of immature animals to mature females was 235 to 297. Since the normal birth rate for this species is one young per female (Mohr, 1933; Guthrie, 1933) these figures indicate a possible loss of 62 young or 21 per cent of the reproductive potential. Various authors have indicated a high juvenile mortality, such as possibly indicated in this study. Certainly the small number of young indicates that not more than one young per female was the rule in this colony.

The color, length and density of the fur was different for different size classes in the im-

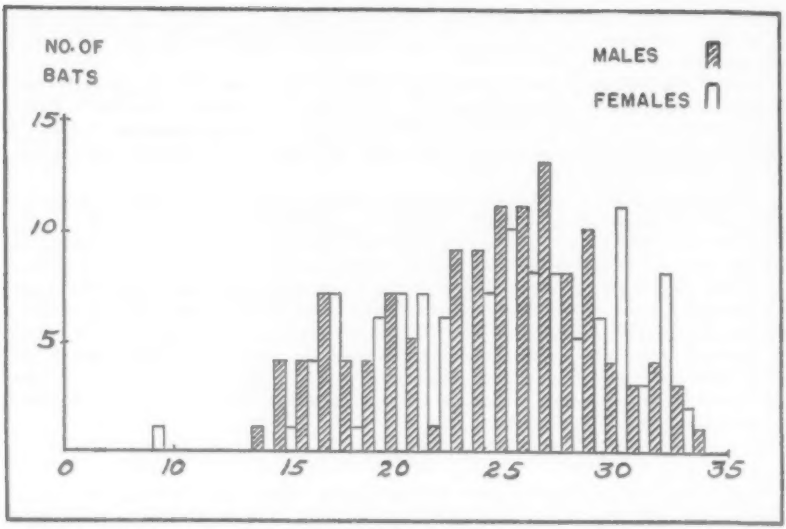

FIG. 1.—Distribution of 235 immature *Myotis l. lucifugus* according to length of forearm in millimeters.

mature bats. The hair was thin, short, and a dark gray color in the smallest individuals, (forearm measuring from 9 to 15 mm.). However, it gradually increased in length and density with age. The amount of gray gradually became less as the size increased, until most of the individuals, with a forearm measuring 20 mm. or more, appeared black. The hair increased further in length and density on these animals when they became older. The largest immature specimens had hair as long and as heavy as that of the adults. The hair was slightly tinged with dark brown in a few of the larger specimens.

The adult females could be readily distinguished from immature bats by their lighter brown coat as well as by their larger size. The young showed considerable variation in size. The length of the forearm varied from 9 to 32 mm. in the females, and from 14 to 34 mm. in the males. The distribution of animals throughout this size range is shown in Figure 1.

This wide spread in size evidently represents a long parturition period for the colony. This differs from the findings of Sherman (1937) for a different genus. He studied a large colony (about 10,000) of free-tailed bats and found that all the young were born within an interval of two or three weeks and that nine out of ten were born within a period of one week. This could scarcely be true for the colony of *Myotis* under consideration.

Little information is available about the size of newborn *Myotis l. lucifugus*. Sherman (1930) did considerable work with *Myotis austroriparius*, which is a bat comparable in size with *Myotis l. lucifugus* (Miller and Allen, 1928). The length of the forearm for *Myotis austroriparius* is given as 9.8 mm. for a newborn female and 11.2 mm. for a newborn male. Therefore the length of the forearm in a newborn *lucifugus* might be about 10 mm. The smallest lengths found in this study were 9 mm. in a female and 14 mm. in a male. The former appeared less than a day old. Its hair was short, thin, and dark gray, which would be true for a young specimen of this species. This was the only bat of that size collected and may well represent the close of the parturition period for the colony, which would therefore be about July 13.

The largest immature bats had a forearm measuring 34 mm. There is scarcely any information on the rate of growth for the young of this species. Sherman (1930), referring to

Myotis austroriparius, gives the following lengths (mm.) of the forearm: Newborn female, 9.8; newborn male, 11.2; average, 10.00. One-day-old male, 11.0; two one-day-old males, 11.2; one-day-old female, 10.5; average, 10.9. Two-day-old male, 10.3; two-day-old female, 10.8; average, 10.6. Three-day-old male, 11.7. These figures roughly indicate an increase of .5 mm. per day.

Cagle (1950) studied the free-tailed bat (*Tadrida mexicana*) of Texas, which is a larger species, and observes: "Young bats increase rapidly in size. The mean size of males increased from 2.68 cm., July 9, to 4.08 cm. August 5; mean size of females from 2.70 cm., July 9, to 3.98 cm., August 5." The average growth for both males and females of this species was .469 mm. per day for the 27-day period.

Certainly *Myotis lucifugus*, a much smaller bat, could not be expected to exceed that growth rate, and therefore the 25-mm. difference in the length of the forearm found in this colony might represent at least 50 days or a little over seven weeks. On this basis the specimens collected indicate a period of parturition for the colony of about seven weeks. This would establish the birth dates as May 23 to July 14.

It is obvious that, as represented in Figure 1, the height of the parturition period came about June 26 and that the greater portion of the colony (51.4 per cent) were born during a two-week period which would be June 22 to July 5, inclusive. Since the above percentage is based upon survivors in the population on July 14, actually more than 51.4 per cent probably were born during the two-week period indicated, because some casualties undoubtedly occurred.

Mohr (1933) studied *Myotis l. lucifugus* in Pennsylvania and found young born as early as June 17 and later than July 5. He says several pregnant females were taken on July 16. This indicates a similar long period for this same species in Pennsylvania.

The color varied considerably in adult females, ranging from a dark brown to a medium chocolate brown. The hair of the larger individuals was lighter. The hair of the adults was quite long and heavy on the dorsal side and much shorter and lighter on the ventral side.

The length of the forearm of mature females varies slightly. The minimum length recorded was 35 mm. and the maximum length was 42 mm. The mean length was 37.369 mm. The mean deviation for the 295 individuals was .853 mm., which was less than the standard deviation, which was 1.025 mm. The standard error for this group was ±.059 mm.

Weights were not taken for the above specimens because of a probable differential loss of weight through dehydration due to manner of exposure and time exposed while dismantling the building. Judging from the appearances of the adult females their weight would show considerable variation.

LITERATURE CITED

Cagle, F. R. 1950. A Texas colony of bats, *Tadarida mexicana*. Jour. Mamm. 31: 400–402.

Guthrie, Mary J. 1933. The reproductive cycles of some cave bats. Jour. Mamm. 14: 199–216.

Miller, G. S., Jr., and G. M. Allen. 1928. The American bats of the genera *Myotis* and *Pizonyx*. U. S. Nat. Mus. Bul. 144: 218.

Mohr, C. E. 1933. Observations on the young of cave-dwelling bats. Jour. Mamm. 14: 49–53.

Sherman, H. B. 1930. Birth of the young of *Myotis austroriparius*. Jour. Mamm. 11: 495–503.

———. 1937. Breeding habits of the free-tailed bat. Jour. Mamm. 18: 176–187.

LeRoy C. Stegeman, *State University of New York, College of Forestry, Syracuse 10, New York.* *Received February 13, 1953.*

BATS FROM SOUTHERN TAMAULIPAS, MEXICO

The collection of Dr. George M. Sutton, Department of Biology, University of Oklahoma, contains a small series of bats from southern Tamaulipas, collected in 1949. The

species represented are not many, nor are they particularly rare. They are, however, tropical kinds which approach the northern limit of their distribution in this region. It seems important, therefore, that these records be made available to those working on the fauna of Tamaulipas.

The specimens from Pano Ayuctle were caught in a trammel net and were preserved by Dr. Sutton. The specimens from the other localities were taken in caves by William B. Heed and C. Richard Robins. Since little is known of the reproductive pattern of bats, I have included the pertinent details available for these specimens. With regard to nomenclature, when a name used here is not listed by Miller (Bull. 128, U. S. Nat. Mus., 1924) the authority for that particular combination is given in parentheses.

I am indebted to Dr. Sutton for the opportunity to study this collection, and to Dr. William H. Burt for his helpful editorial suggestions.

ACCOUNT OF SPECIES

Glossophaga soricina leachi Gray.—Five mi. NE Antiguo Morelos, near El Pachón, 1 female, May 19.

Sturnira lilium parvidens Goldman.—Pano Ayuctle, near Gómez Farías, 1 male, 1 female, January 16. This bat has been recorded in Mexico from Campeche, Guerrero, and Veracruz. J. A. Allen (Bul. Amer. Mus. Nat. Hist., 3, (1): 181, 1890) lists a specimen from Jalisco under the name "*Sturnira lilium*." However, in examining this specimen I find it is of the species *ludovici*.

Artibeus jamaicensis jamaicensis Leach.—Pano Ayuctle, near Gómez Farías, 6 males (2 in alcohol), 5 females (2 in alcohol), January 16–21, March 18; 4 mi. N Antiguo Morelos, near El Pachón, 5 males, 7 females, March 13. Six of the seven females collected in March contained one embryo each, ranging in size from 20 to 38 millimeters. Three of the five males collected at the same time had descended testes.

Artibeus lituratus palmarum Allen and Chapman. (Hershkovitz, Proc. U. S. Nat. Mus., 99: 445, 1949).—Pano Ayuctle, near Gómez Farías, 1 male, 2 females, January 20, March 18. The skulls of *palmarum*, at least from this area, differ from those of *jamaicensis* in size, in proportions, and in having a well-developed anteorbital and supraorbital ridge. The females taken on March 18 carried one embryo each. These measured 24 and 36 millimeters.

Artibeus cinereus toltecus Saussure. (Hershkovitz, Proc. U. S. Nat. Mus., 99: 449, 1949).—Pano Ayuctle, near Gómez Farías, 1 male, 2 females, January 18–24; Rancho del Cielo, 5 mi. NW Gómez Farías, 3300 ft., 3 males, 1 female, March 16, July 2. One of the males taken in March had descended testes, and the female taken on July 2 carried a small embryo.

Centurio senex Gray.—Pano Ayuctle, near Gómez Farías, 1 female (in alcohol), January 24. This specimen was caught in the lower part of the net, a short distance above the ground. Apparently it was attacked during the night for, when found, its head had disappeared. However, so characteristic are the striations of the wing membrane between the fourth and fifth metacarpals, along with the unpigmented area between the second and third metacarpals, that there can be no doubt as to its identity. This bat was known in Mexico only from Veracruz.

Desmodus rotundus murinus Wagner.—Pano Ayuctle, near Gómez Farías, 1 female, January 22; 5 mi. NE Antiguo Morelos, near El Pachón, 1 immature male, May 19. The net in which the female was caught was set up in thick woods. The young male I would judge to be no more than about three weeks old at the time of capture.

Diphylla ecaudata centralis Thomas. (Goodwin, Bul. Amer. Mus. Nat. Hist., 79: 138, 1942).—Five mi. NE Antiguo Morelos, near El Pachón, 1 male, March 13. This is the most northern record for the genus. It is known in Mexico from Campeche, Hidalgo, and Veracruz.

MEASUREMENTS

Measurements, in my opinion, should always accompany locality records. Not only are data on the variation of species always needed but, in dealing with poorly known faunas

TABLE 1.—*Measurements (in millimeters) of bats from southern Tamaulipas, Mexico*

	G. S. LEACHI	S. L. PARVIDENS	C. SENEX	A. J. JAMAICENSIS	A. L. PALMARUM	A. C. TOLTECUS	D. R. MURINUS	D. E. CENTRALIS
Number measured	1	2	1	23	3	6	1	1
Forearm	36.2	39.6, 39.9	42.1	58.9, 59.3, 59.3, 61.7	—	—	59.6	—
Metacarpal III	36.4	38.2, 39.2	38.3	55.8 (53.0–57.0)	59.7, 63.0, 66.6	40.4 (38.8–41.7)	55.5	54.9
Greatest length of skull	21.3	21.9, 21.8	—	28.1 (27.4–28.9)	28.4, 30.2, 29.8	21.1 (19.9–21.8)	24.6	—
Condylobasal length	20.1	19.4, 19.4	—	24.9 (24.3–25.7)	25.5, 26.3, 26.4	18.9 (18.1–19.4)	21.9	20.8
Zygomatic breadth	9.0	13.8, 13.3	—	16.9 (16.4–17.5)	18.0, 18.8, 18.8	12.3 (11.7–13.1)	12.0	12.8
Mastoid breadth	8.9	11.8, 11.9	—	14.8 (14.3–15.5)	15.9, 17.1, 16.1	10.9 (10.3–11.8)	12.6	—
Palatal length	11.2	9.1, 9.3	—	13.6 (13.0–14.5)	13.2, 14.0, 14.2	9.6 (9.5–9.8)	9.5	7.3
Postorbital constriction	4.6	5.5, 5.4	—	7.0 (6.7–7.5)	6.2, 6.1, 7.1	5.3 (5.0–5.6)	5.7	—
Maxillary tooth row	7.1	6.4, 6.4	—	10.0 (9.6–10.3)	10.2, 10.7, 10.5	6.9 (6.7–7.2)	3.4	3.5
Maxillary width across molars	5.7	7.9, 8.0	—	12.5 (11.9–12.8)	12.6, 12.9, 13.3	9.1 (8.7–9.2)	—	—
Mandibular ramus	—	14.1, 14.2	—	19.2 (18.6–20.3)	19.4, 20.1, 20.6	13.3 (12.8–13.7)	14.9	13.9
Canine to condyle	—	13.3, 13.4	—	18.3 (17.3–19.3)	18.8, 19.5, 19.9	13.3 (12.5–14.2)	12.5	3.4
Mandibular tooth row	—	7.5, 7.2	—	10.9 (10.5–11.4)	11.0, 11.5, 11.6	7.3 (7.1–7.5)	4.5	3.4

such as the neotropical fauna, it seems rather pointless to mention that *Artibeus cinereus* is found in a particular locality without indicating to the reader what is understood to be *Artibeus cinereus*. Although today's name may not apply tomorrow, the specimen, if well characterized, will still be identifiable and useful.

The measurements for the preceding specimens appear in Table 1. The following should be clarified:

Forearm. The greatest length of the radius-ulna including the carpals.

Metacarpal. The greatest length of the metacarpal including the carpals.

Maxillary and mandibular tooth rows. The greatest length from the last molar to the anterior face of the canine.

Canine to condyle. The greatest length from the condyle to the anterior face of the lower canine.

The measurements of males and females have not been separated since no size difference was apparent. The mean, where calculated, is followed by the extremes in parentheses. When the individual measurements are given for more than one specimen, those of the male precede those of the female or females.—Luis de la Torre, *Chicago Natural History Museum, Chicago 5, Illinois. Received January 5, 1953.*

A RECORD OF THE HOARY BAT FROM A CAVE

During the winter of 1950 a mummy of a hoary bat (*Lasiurus cinereus*) (No. 3322 in the University of Minnesota, Museum of Natural History) was found on the floor of a man-made cave at St. Paul, Minnesota. The mummy was in relatively poor shape. Considering the environmental conditions, it is probable that the bat had died during the latter part of the preceding summer. The location of the bat suggested that it had died hanging to the ceiling of the cave, and remained there until shortly before it was found. The chamber in which it was discovered was nearly 150 yards from the entrance of the cave and was located so that no light penetrated to it. The presence of one of these tree bats in a cave is rather unusual. Hahn (Biol. Bull., 15: 141–147, 1908) reported finding two skulls of the hoary bat and over 200 skulls of the red bat (*Lasiurus borealis*) in Shawnee Cave, Mitchell, Indiana and Mumford (Jour. Mamm., 34: 121, 1953) reported a hoary bat skull from Hamer Cave, Mitchell, Indiana. This, to my knowledge, is the third record of this species entering a cave.—James R. Beer, *University of Minnesota, St. Paul. Received February 2, 1953.*

SECOND RECORD OF THE HOARY BAT IN FLORIDA

A factor contributing to our limited knowledge of the migratory habits of the hoary bat, *Lasiurus cinereus* (Beauvoir), has been the scarcity of records concerning its distribution at various times of the year. Because of this, it is worthwhile to mention a specimen found on October 26, 1952, on Santa Rosa Island, Escambia County, Florida.

To the best of my knowledge, this is the second record of this species in the State of Florida, the first being cited by Chapman (Bul. Amer. Mus. Nat. Hist., 6: 343) as having been collected by J. H. P. Bell in the vicinity of Gainesville, Alachua County, Florida, during February, 1891. Other records from nearby states are mentioned by G. M. Allen (*Bats*: 255), including, ". . . specimens from South Carolina in mid-January, from Montgomery (Georgia) in late January, Sterling (Georgia) in March. . . ." These come from much later in the winter and emphasize the early nature of the present record.

Santa Rosa Island is a long off-shore bar that skirts the Gulf coast of the most western part of the state. The specimen was found dead, and in an advanced state of decay, among the sand dunes about ten yards north of the only road that traverses the island, and about five miles west of the town of Destin, Florida. The decayed nature of the bat made sex determination impossible, but the pelt was still intact and the skeleton nearly complete. The following measurements were taken from the cleaned skeleton, which is in my private collection, No. F8: skull length (condyle to tip of incisor), 17.7 mm.; zygomatic width, 13.0; tail vertebrae, 55.5; hind foot, 12.7; and humerus (head to trochlea), 35.3. I am indebted to

Dr. H. B. Sherman of the Biology Department of the University of Florida for the initial identification.—R. Cooley, *Department of Biology, University of Florida, Gainesville, Florida. Received January 31, 1952.*

RECORDS OF THE SPOTTED BAT (*EUDERMA MACULATA*) FROM CALIFORNIA AND UTAH

Through the generosity of Mr. James E. Cole, National Park Service, Omaha, Nebraska, and of Mr. Adrey E. Borell, Soil Conservation Service, Albuquerque, New Mexico, I have permission to record two specimens of the spotted bat, *Euderma maculata* (J. A. Allen), given by them to the Museum of Vertebrate Zoology.

Mr. Cole informed me (*in litt.*, Sept. 4, 1952): "The information that I received was that Miss June Garvin found [in May, 1939] the bat in a torpid condition hanging on the side of her porch in Twentynine Palms [San Bernardino County, California]. Her home was then near the boundary of Joshua Tree National Monument alongside the road entering the monument from Twentynine Palms. Miss Garvin took the bat to the local high school where it subsequently died and was pinned onto a drying board. When I saw the mummified specimen I recognized it since we had a specimen in the Yosemite Museum collection. With the permission of the high school principal I obtained the specimen and sent it to the Museum of Vertebrate Zoology. This is all the data I can provide." Mr. Cole also informed me that he was never able to talk to the original collector and these data are secondhand.

When the specimen was received at the Museum so much of the skin and hair had been destroyed by insects that it was preserved as a complete skeleton. It was a fully adult male and is now no. 102744 in the collection.

The specimen received from Mr. Borell was found by him on July 25, 1947, floating in a shallow reservoir five miles northwest of Monticello, San Juan County, Utah. Because it had begun to decompose it was preserved entire in a formaldehyde solution. It is now no. 114978 in the collection of the Museum of Vertebrate Zoology preserved in alcohol. It is also a fully adult male with slightly worn teeth. It is in fair condition except that its bones have been partly decalcified by long immersion in formaldehyde solution.

These specimens are the eleventh and twelfth of this species known to me to be preserved for study. The records are the sixth for California and the second for Utah.—Seth B. Benson. *Museum of Vertebrate Zoology, Berkeley, California. Received November 18, 1952.*

PRESENCE OF THE REDDISH HOWLING MONKEY (*ALOUATTA GUARIBA CLAMITANS* CABRERA) IN ARGENTINA

Up to now, the subfamily Alouattinae was represented in Argentina by only one species, the black howler, *Alouatta caraya* (Humboldt), known to inhabit this country from many years back. With this opportunity we have the satisfaction of incorporating another species of this genera into the list of the mammal fauna of our country, with which the total number of Primates now amounts to five species. The specimen referred to in this note was secured during our last trip to the Territory of Misiones (N.E. Argentina), made for our Museum at the beginning of 1952.

Among the reddish howling monkeys, *Alouatta guariba* has long been known to inhabit a narrow strip of territory along the Atlantic coast of eastern Brazil, from Bahia to Rio Grande do Sul. Later records have extended the distribution of the southern form (the one treated here) towards the west, into the southern Brazilian states, ours being one of the most western records for this form.

The physiography of the northeast part of the Territory of Misiones is very similar to that of the neighboring regions of Brazil, inasmuch as it has a rolling ground, sometimes hilly, covered with dense coniferous forests of Brazilian pine (*Araucaria angustifolia*) to which the distribution of this monkey seems to be related. The specimen we possess was secured in a locality within this geographic area in the boundary between the water systems of the Uruguay and Parana rivers.

With reference to nomenclature I follow Dr. Cabrera's statement given in *Ciencia* (Mexico, 1: 402–405, 1940). He also kindly gave us, in a letter, more details about the intricate taxonomic history of this species. The specimen's characteristics are as follows:

Total length, 1130 mm.; head and body, 520; tail, 610; ear, 25; hind foot, 130. Skull, greatest length, 121 mm.; basal length, 104; palatal length, 46; zygomatic breadth, 80; braincase breadth, 53; interorbital constriction, 12; breadth of rostrum, 30; upper tooth row C–M^3, 43.5; mandibular length, 99.1; length of mandibular ascendent branch, 78; lower tooth row C–M_3, 49. Male adult, No. 52-41 Museo Argentino de Ciencias Naturales, stuffed skin and skull; collected March 5, 1952, by W. H. Partridge (No. 58). Locality: Territorio de Misiones, Departamento de Frontera, Tobuna, approximately 600 meters altitude.

Comparing the measurements of the skull of our specimen with those of some specimens of similar size given by Vieira (Papeis Avulsos, Sao Paulo, 4: 1-31, 1944), in ours they are all definitely larger than in the Brazilian ones. As regards coloration, it agrees with the general appearance of the subspecies.—JORGE A. CRESPO, *Instituto Nacional de Investigacion de las Ciencias Naturales y Museo Argentino de Ciencias Naturales, Buenos Aires.* *Received November 24, 1952.*

OCTOBER BREEDING OF *PEROMYSCUS* IN NORTH CENTRAL COLORADO

Although *Peromyscus maniculatus* is known to breed throughout the year in some parts of its range, in Colorado the breeding cycle is usually restricted to the spring and summer months, with occasional records into September (Warren, THE MAMMALS OF COLORADO, 1942). Trapping during the fall of 1952 in the plains-foothills country of Larimer County (elevations from 4900–6300 feet) yielded widespread evidence of a later-than-usual breeding cycle extending at least through October.

Of 23 females trapped in five localities during October, nine were lactating and one was pregnant, and of five males trapped in one area on October 3, two possessed testes in the scrotal position. In addition, a lactating *Reithrodontomys megalotis dychei* was collected from a sixth locality on October 23. Eight of the female *Peromyscus* in breeding condition, including the pregnant mouse, were collected between October 26 and 31. The gravid female contained five embryos averaging 13 mm. in length and weighing one-fourth gram each.

According to Manville (Jour. Mamm., 33: 389, 1952), a mid-October breeding cycle among Michigan *Peromyscus* in 1950 had no apparent correlation with local weather conditions. Winter breeding in Kansas during 1944–45 (Brown, Ecology, 26: 308–309, 1945), on the other hand, appeared to be correlated with above-normal temperatures and subnormal precipitation, and the same can be postulated for the October cycle in Colorado, as the fall of 1952 was the driest on record, with above-average temperatures and a minimum of cloud cover and wind.—RICHARD G. BEIDLEMAN, *Zoology Department, Colorado A & M College, Fort Collins.* *Received December 8, 1952.*

SWIMMING ABILITY OF THE GRASSHOPPER MOUSE

Near midnight on June 13, 1952, while collecting toads in a small arroyo 5 mi. N and 3 mi. W of La Gloria, 500 ft., Nuevo León, México, we saw a grasshopper mouse, *Onychomys leucogaster*, swim. One of us (Findley) was standing on one bank while the other, approaching the water from around a thicket on the other bank, flushed the mouse. It ran a short distance, leaped into the water, swam obliquely across to the other bank, a distance of approximately 12 feet, and climbed out. The mouse then shook the water from its pelage. The mouse was shot as it attempted to escape in the thorny scrub. The animal swam by kicking its hind legs in unison while "dog-paddling" with its front legs. Its head was carried well above water. We have found no previous record of *Onychomys* swimming.

The specimen, KU 49571, is a subadult female in gray pelage. The external measurements are: total length, 156 mm.; length of tail, 55; length of hind foot, 25; height of ear from notch, 20. Cranial measurements are: greatest length of skull, 28.7; zygomatic breadth, 13.6; breadth of braincase, 11.8; interorbital constriction, 4.8; length of nasals, 11.2; shelf of bony palate, 4.5; palatine slits, 5.5; alveolar length of maxillary tooth-row, 4.5. We have

identified the specimen as *Onychomys leucogaster longipes* (Merriam). This record provides an extension of the known range of this subspecies of approximately 35 miles southwestward from Laredo, Webb County, Texas.—Robert J. Russell and James S. Findley, *Museum of Natural History, University of Kansas, Lawrence.* *Received December 12, 1952.*

PREGNANCY RATES IN TWO DIFFERENT SAMPLES OF BROWN RATS

The conventional procedure to determine the reproduction dynamics of small mammals consists in capturing a large number of wild animals and selecting from this sample the females capable of reproduction. The results of such investigations are supposed to mirror the conditions prevailing among the total wild population. It is thus, explicitly or implicitly, assumed that the captured animals represent a true cross-section of the entire population.

Emlen and Davis (1948) and Peters (1948) have, however, pointed out that the composition of such samples need not necessarily be a representative one. The specific method of capturing the animals may conceivably operate as a selective factor and consequently bias the results in one or the other direction. What the exact nature of these factors is, and in what specific manner they might affect the results, is still a moot point. It is, however, generally assumed that the influence of selective factors can be reduced to an insignificant minimum if the results are based upon a sufficiently large number of animals. The objective of this paper is to show that even this precaution need not eliminate the operation of selective factors.

Between November 20, 1949, and March 31, 1950, a large number of brown rats were captured in various localities of the city of Berlin. The majority of them were caught by means of break-back traps. The others were either killed by means of sticks or hunted down by dogs, a few were found dead after gassing flour mills. In the following the terms "trapped" and "hunted" will be used to distinguish the two groups of rats (*Rattus norvegicus*).

In our total collection we found 1496 females with a head-body length of 160 mm. and more. These were considered to be capable of reproduction. (This determination was deducted from a still unpublished investigation on brown rats in Berlin where the author found that 50 per cent of the females measuring 163 mm. head-body length had a perforated vagina.) 1142 (=76.3%) belonged to the "trapped" and 354 (=23.7%) to the "hunted" group.

Obduction of the 1496 specimens revealed that 268 were visibly pregnant. The uteri of 260 rats were removed and the embryos uncovered. The lengths of the embryos (head-trunk) were then determined by means of calipers. If the length was less than 2 mm. it was simply registered in the protocol as "less than 2 mm." The measurements from 2 to 3.5 mm. are approximate ones. We could not determine the sizes of the embryos of eight litters either because of advanced decay or because of the extreme mutilation some animals had suffered while being captured.

Brown rats have an average gestation period of 24 days. As Emlen and Davis (*loc. cit.*) have shown, the embryos become macroscopically visible on the seventh day after insemination. The females are thus visibly pregnant only for a period of 18 days. On a macroscopic examination, the pregnancy of about 25 per cent of the actually inseminated females will, therefore, escape detection.

In the first half of the pregnancy period, the embryos of tame laboratory rats will reach an average length of 4.4 mm (Henneberg, 1937). This is a period of slow growth. In the second half of the gestation, the length of the embryos increases very rapidly (Emlen and Davis). Thus the 12th day in the life of an embryo constitutes a turning point. This point is not only characterized by a rapid increase in volume of the embryo but also by some other remarkable changes in the uterus horns.

Assuming that in a large collection of pregnant rats every stage of the embryonic development will be represented by an equal number of specimens, one may justly expect that one third of the number of macroscopically visible embryos will be of a length less than, or equal to, the average length reached on the 12th day of the gestation period. In other words,

TABLE 1.—*Data for two different samples of pregnant brown rats*

	TRAPPED		HUNTED	
Days after insemination	7–12	13–24	7–12	13–24
Average head-trunk length of embryos in mm.	<4.5	>4.5	<4.5	>4.5
Number of pregnants actually found	72 (=48.3%)	77 (=51.7%)	46 (=41.4%)	65 (=58.6%)
Theoretically expected number	49.7 (=33.3%)	99.3 (=66.7%)	37.0 (33.3%)	74.0 (66.7%)
Difference	+15.0%	−15.0%	+8.1%	−8.1%

these embryos of an age of 7 to 12 days have a length of less than 4.5 mm. The other two thirds of the macroscopically visible embryos represent the second half of the gestation period (13th to 24th day) and their length will measure 4.5 mm. or more. Arranging our material from this point of view, we obtained the following results.

Neglecting the eight whose embryos could not be measured, it appears that only 149 or 13 per cent of the "trapped" group were visibly pregnant, whilst in the "hunted" group the pregnant rats amounted to 111 or 31.4 per cent. This difference is an obvious indication of the fact that a larger percentage of pregnant females is obtained if rats are driven out of their hiding places than when they are caught in traps.

Another difference between the two groups becomes apparent if we consider the state of pregnancy at the time the animals were captured. The results are presented in Table 1.

As the table shows, 48.3 per cent of the trapped pregnants were in the second quarter of their gestation period. According to the law of chance, however, one should have expected the number to be only 33.3 per cent. Thus there were 15 per cent more "trapped" females in this particular stage of pregnancy than was to be expected theoretically. On the other hand, the pregnants in the second half of their gestation period were found to be considerably less frequent. They amounted to only 51.7 per cent as against a theoretical frequency of 66.7 per cent.

It may, therefore, justly be inferred that female rats in the first half of the pregnancy period are more responsive to traps than those in the second half of the pregnancy period, i.e. at a time, when the animals are comparatively heavy and clumsy.

A similar picture is obtained from the hunted group of pregnant rats although in this group the deviations from the theoretical percentages are not so great as in the trapped group. The difference between the actual and the expected frequency is 8.1 per cent, which means that even when rats are captured by forcibly driving them out of their hiding places, the various stages of pregnancy are not equally distributed over all pregnants caught.

The obvious reason for these findings may be that female rats in advanced stages of pregnancy become less and less mobile and their tendency to leave the nest is reduced accordingly. Not only the increasing size of the embryos but also their number will be of importance in this connection. Furthermore, the radius of activity of pregnant rats is known to be diminished (Munn, 1950). Consequently, their chances to meet with a trap will be reduced correspondingly. Rat collections obtained by trapping will, therefore, contain a smaller proportion of these females.

Such disproportion in the number of females in the later stages of pregnancy is not entirely eliminated by hunting the rats. It should, however, be noted that the discrepancy between the expected and the actual frequencies is here much smaller than in the trapped group.

The degree of discrepancy between the actual and the theoretically expected numbers in the two groups will of course vary according to the skill of the trapper and the number of traps set out, or to the experience of the hunter and the intensity of search for the hiding places of the rats. It will, however, not be possible by either method to eliminate such discrepancies entirely.

In the author's view, two particular problems should be explored by future research: (a) The general behaviour of pregnant rats in their natural habitat. (b) The various factors affecting the rat-trap relationship.

It will then be possible to draw more reliable conclusions on the actually existing population dynamics from a sample of specimens collected in the course of a zoological field investigation.

LITERATURE CITED

EMLEN, J. T. AND DAVIS, D. E. 1948. Determination of reproductive rates in rat population by examination of carcasses. Physiol. Zool., 21: 59–65.

HENNEBERG, B. 1937. Normentafel zur Entwicklungsgeschichte der Wanderratte (Rattus norvegicus Erxl.) Jena, G. Fischer.

MUNN, N. L. 1950. Handbook of Psychological Research on the Rat. Boston, Houghton Mifflin Co.

PETERS, H. 1948. Ergebnisse der Rattenbekämpfung in Stuttgart 1944 bis 1948. Stuttgart, Hippokrates-Verlag.

KURT BECKER, *Robert-Koch-Institut für Hygiene und Infectionskrankheiten, Berlin-Dahlem, Germany.* *Received December 8, 1952.*

NOTES ON NESTS OF THE MEADOW JUMPING MOUSE, *ZAPUS HUDSONIUS*

Relatively few nests of the meadow jumping mouse *Zapus hudsonius* have been described. Observations on nests have been reviewed by Babcock (Amer. Nat. 48: 485–490, 1914.) and Quimby (Ecol. Monog. 21: 61–95, 1951.). Additional records have been reported by Dilger (Jour. Mamm. 29: 299–300, 1948), Grizzell (*ibid.* 30: 74–75, 1949.), and Eadie (*ibid.* 30: 307–308, 1949.). In a study of *Z. hudsonius* in Ohio the writer acquired field data on nests of this species found in northeastern Ohio which are worthy of being placed on record.

Robert M. Goslin dug a specimen of the jumping mouse out of hibernation at Independence (Cuyahoga County) on April 25, 1930, while excavating an archeological site. The nest was 11 inches below ground and consisted of a ball of leaves and shredded corn husks which filled a spherical chamber. The jumping mouse came out of its torpid state and became active when warmed.

Over a period of years Bernhardt Raithel has observed and collected a number of jumping mice on his farm near Rootstown in Portage County. In the spring of 1943 he discovered two nests each with four young. Another nest was accidentally destroyed while spading an earthen dam around his fish pond on July 18 of that year. Two of the four young were killed by the shovel. On October 5, 1947, he observed a jumping mouse run out from a mound of loose earth which had been piled at the edge of the pond some four or five months earlier. Upon examination a nest of dry grass containing six jumping mice was discovered. Two runways joined the nest. All specimens were females. Possibly these animals were preparing for hibernation. Following are the range and average of measurements in grams and millimeters. Weight, 5.4–6.0 (5.7); total length 160–166 (163); tail length 100–106 (103). The hind foot of all measured 27 mm. All of the nests found by Mr. Raithel were in loose earth 8–10 inches below the surface.

Russell Foldessy uncovered a nest of the jumping mouse in a year-old sand bank at Spring Valley Nursery near Streetsboro in Summit County on August 15, 1948. The nest was a ball of grasses some five inches in diameter containing one adult with three very small, naked young. The nest was located about four inches below ground in loose sand.—RALPH W. DEXTER, *Department of Biology, Kent State University, Kent, Ohio.* *Received November 24, 1952.*

A MULTIPLE CATCH OF *CRATOGEOMYS*

Perusal of the literature reveals numerous records of catches of two pocket gophers, *Geomys* and especially *Thomomys*, in various sex and age combinations from the same burrow system, but I know of only two instances in which three individuals were taken from the

same burrow: In Oregon, Horn (Jour. Mamm., 4: 37-39, 1923) took a lactating female and four immature males of *Thomomys towensendi* from the same tunnel; in California, Burt (Murrelet, 14: 42, 1933) trapped an adult female and three immature females of *T. bottae* from the same hole. In each of the above instances the nursing female was pregnant and contained six embryos. Plural catches have not been reported previously in the genus *Cratogeomys*; therefore, it seems of interest to make known the following observations.

On June 24, 1952, the writer was collecting pocket gophers at a locality 3 mi. S and 3 mi. E Muralla, 3800 ft., Coahuila, Mexico. Gopher burrows were found under clumps of lechuguilla, *Agave lechuguilla*, one of the dominant and most abundant plants in this area. Entrance was made into the underground runway of one burrow system, and two traps were set in the usual manner, one in each direction. Later in the evening, when I checked the sets, a nursing female, *Cratogeomys castanops*, was captured in one trap; the other trap was undisturbed. The sprung trap was reset in the same hole. The following morning the two traps of this set each contained a gopher. One was an adult male and the other an immature female. The adult female did not have embryos. The presence of the male gopher with the female and her young is unusual, and I know of no previous record of this combination in pocket gophers. Traps set in an adjacent burrow system were undisturbed. This seemingly vacant burrow could have been that of the male.

External measurements of the adult male and female are respectively: total length, 270 mm., 265; length of tail, 80, 78; length of hind foot, 35, 38. The immature female measured: 190, 54, 30. The specimens have been identified as *Cratogeomys castanops subsimus* Nelson and Goldman.—Robert J. Russell, *Museum of Natural History, University of Kansas, Lawrence. Received December 31, 1953.*

MELANISM IN THE VARYING HARE, *LEPUS AMERICANUS VIRGINIANUS*

The scarcity of information concerning black snowshoe rabbits warrants publishing the following records for northern New York: In January, 1951, two miles east of Carthage, Jefferson County, New York, a small male was shot in a cedar swamp by Mr. William Dufner. The measurements were: total length, 445 mm.; tail, 25; hind foot, 140; ear from notch, 63 mm. Another male found dead by the author, on a road one mile northeast of Croghan, Lewis County, New York on August 20, 1951, weighed 5¾ lb. and measured: total length, 572 mm.; tail, 70; hind foot, 115; ear from notch, 98 mm. The testes (abdominal) measured 65 mm.

The former specimen was totally black and the base of the hairs was bluish-black. The latter specimen was black except for some dark brown-colored patches dorsally and a few white hairs in the axillary region of both forelegs.—David C. Gordon, *1012 Indianapolis Avenue, Riverside, California. Received January 3, 1953.*

LATE-BREEDING SNOWSHOE HARE

On November 28, 1952, Emilio Riciputi of Portsmouth, New Hampshire, killed an "almost completely white" snowshoe hare (*Lepus americanus virginianus*) in Brookfield, N. H. When opened, the hare contained two well developed foetuses, each about 115 mm. in length. —Hilbert R. Siegler, *New Hampshire Fish and Game Department, Concord. Received January 24, 1953.*

OCCURRENCE OF THE HARBOR PORPOISE AT POINT BARROW, ALASKA

On August 6, 1952, Professor Ira L. Wiggins, Director of the Arctic Research Laboratory at Point Barrow, Alaska, acquired from David Otoana, an Eskimo fisherman, an adult female harbor porpoise, *Phocoena vomerina* (Gill), caught that same day by Otoana in his fish net in the northwestern extremity of Elson Lagoon at latitude 71° 20′ 45″ North and longitude 156° 35′ 30″ West. The animal weighed 109 pounds and Mr. Norman J. Wilimovsky recorded its length as 162 cm. from the snout to the base of the tail-notch. The specimen was prepared as a skeleton and is preserved in the United States National Museum with catalogue number 294800.

On August 23 at the same place, Clay Kaigelak, an Eskimo, obtained another porpoise,

of the same species, by striking it with the butt of his rifle. The porpoise was in shallow water and was seen first by Kaigelak's ten-year-old son. On September 2, 1952, when we were in Barrow Village, Kaigelak described the "little whale" to our companion, Edward G. Campbell, and remarked that it was the first one he had seen. We accompanied Kaigelak to his meat house, a frame structure 12 x 14 feet. There he opened a trap-door in the floor, then a second trap-door two and a half feet below the first, and hauled up a rope on the end of which the porpoise was suspended. It was solidly frozen, having been in the earthen cavity that Kaigelak had hollowed out of the permanently frozen ground. He willingly sold the specimen when we mentioned its usefulness to the Arctic Research Laboratory, and added that he had hardly known what to do with the animal and so had concluded that he would eat it.

This young calf weighed only 22½ pounds, measured 92.4 cm. along the curve of the back from the tip of the snout to the base of the notch between the caudal flippers, had a notably deep head (vertically) as is characteristic of the foetus of this species (see Figs. 28–30, Scheffer and Slipp, Amer. Midl. Nat., 39:294, 1948) and on the venter, anterior to the genital opening, there was an aperature (slit) that had accommodated the umbilical cord. The porpoise seemed to have been only a few weeks, or possibly a few days, old when killed.

Each of two other Eskimos from Point Barrow with whom we talked at the Arctic Research Laboratory was familiar with porpoises, and said that the Eskimos made no special efforts to obtain them. One of these men, Adam Levitt, thought that the porpoises occurred regularly at Point Barrow, stated that the back straps were the best part of the animal to eat, that he had eaten part of another early this (1952) summer, and wrote the Eskimo name of the animal as *Ah-vi-sauk*.

The stomach of the adult, according to Norman J. Wilimovsky, contained bones of whitefish, *Leucichthys*. The stomach of the calf was empty.

The calf was preserved in formaldehyde and is catalogued in the United States National Museum as number 294801. We are indebted to Dr. Remington Kellogg, Director of that museum, for verifying our field identification as harbor porpoise.

Although we have not thoroughly searched the literature, we know of no previous record of this species from so far north in North America as Point Barrow, Alaska. Because of the immaturity of the second specimen, we suppose that some young of the harbor porpoise are born on the Arctic Coast of Alaska.—E. Raymond Hall and James W. Bee, *Museum of Natural History, University of Kansas, Lawrence, Kansas. Received December 3, 1952.*

[Contribution No. 1953–1 from the Arctic Research Laboratory under contract Nonr-38700 between the Office of Naval Research, United States Navy and the University of Kansas.]

SIGHT RECORDS OF THE GRAY GRAMPUS, *GRAMPUS GRISEUS* (CUVIER)

In conversation, Dr. Joseph C. Moore of the Everglades National Park has called my attention to the paucity of western North Atlantic records of *Grampus griseus* (Cuvier). It is likely that this whale is not as rare as this would indicate, much as Major Gavin Maxwell has pointed out on pages 261–265 of his book, HARPOON VENTURE (1952), where he describes the abundance of this species off the west coast of Scotland.

On July 14, 1950, some 200 miles east of Cape Cod, three individuals keeping close beside each other were overtaken and passed, our ship going 14 knots. The grampus were making about half our speed as we passed about 50 yards from them.

On August 20, 1952 we encountered a group of over sixty of these small whales near Lat. 40° 00′ N, Long. 71° 30′ W, some 70 nautical miles south of Block Island; visibility was good, and the sea was glassy with a gentle swell. The grampus, in small bunches of four to six, were swimming actively in a variety of directions, though evidently maintaining a general base course at perhaps five knots speed of advance. They were quite frolicsome, sunfishing, pitchpoling, and often breaching clear, sometimes in clean arcuate leaps like porpoises, sometimes falling back head up like a humpback whale. Occasionally one waved the posterior third of the body in the air, again like a humpback. Their closest approach to the ship was about 75 yards, but when we pulled away from the vessel in a dory, they were less shy, passing under us at a depth of about ten feet. They appeared to be in constant vocal com-

munication with each other; a phonographic recording of these rather faint underwater calls was made.

A week later our ship reported a similar encounter some 30 miles further east; there seems little doubt that it was the same species.

Field marks for this form include the high slender dorsal fin, somewhat reminiscent of a killer's, the pale gleam of the back in front of the fin, the rather blunt snout (not as bluff as *Globicephala*), the slender tail with lunate flukes (rather like that of *Delphinus*), which may be seen if the animal breaches. On close approach the characteristic scratch-like markings may be seen. The flipper was not often conspicuous.

As usual with cetaceans, many of the published figures are misleading. Reliable pictures of *Grampus griseus* (Cuvier) are those of W. H. Flower (1872, Trans. Zool. Soc. London, 8, Plate 1) and J. Richard (1936, Resultats Campagnes Scient. Monaco, 94, Plates 6, 7), as well as the characteristic field photographs published by Maxwell (1952, HARPOON VENTURE, Figures 77–82).

Although there has lately been a tendency to refer this species to *Grampidelphis* Iredale & Troughton 1933 (Rec. Austral. Mus., 19: 28–35), I have followed the older custom of using *Grampus* Gray 1828 (in which it was the first species included) because the use of *Grampidelphis* involves acceptance of a conjectural manipulation of an anonymous erroneous type designation of an imaginary species (1829, Zool. Jour., 4: 497), which was ignored as irrelevant for 104 years, only then to be ascribed to a non-binomial author and interpreted as making *Grampus* Gray applicable to the killer whale. Since this type designation is invalid, *Grampus* Gray remains available for *griseus* Cuvier, and does not belong to the killer whale. As long ago as 1862, *Delphinus griseus* G. Cuvier 1812 was designated as the type species of *Grampus* Gray 1828 by J. Reinhardt (Overs. Kong. Danske Vid. Selsk. Forh., 1862, pages 107, 148). For details see the original references and J. R. Ellerman & T. C. S. Morrison-Scott (CHECKLIST OF PALAEARCTIC AND INDIAN MAMMALS, British Museum (N. H.), 1951, pages 739–741), as well as F. C. Fraser (Ann. Mag. Nat. Hist., (12), 4: 942–944, 1951), who reminds us that *Delphinus ventricosus* Lacépède 1804 was founded on a good figure of *Phocoena phocoena* and so cannot be applied to any *Globicephala*, let alone *G. melaena* (Traill) 1809. This synonymy was also pointed out by Thomas Bell in 1837 on pages 481–482 of his popular work, A HISTORY OF BRITISH QUADRUPEDS.—WILLIAM E. SCHEVILL, *Woods Hole Oceanographic Institution, Woods Hole, Massachusetts. Received December 8, 1952.*

[Contribution 654 from the Woods Hole Oceanographic Institution]

FOOD OF A BEAKED WHALE

The stomach from a beaked whale taken in a salmon gillnet off Kushiro, Hokkaido, Japan, was secured by the author. The contents were later examined in Tokyo by Giles W. Mead, U. S. Fish & Wildlife Service, and Dr. Tokiharu Abe, Japan's Tokai Regional Fisheries Laboratory.

The whale, an 18-foot, nonpregnant female, was not examined closely enough to permit positive identification, but Dr. Remington Kellogg, (personal communication) from photographs submitted to him, has ventured the guess that it "may possibly be an immature female, *Ziphius cavirostris*."

Although it was impossible to specifically identify either the whale or the contents of its stomach, it nevertheless appears worthwhile to record such information as was obtained. The stomach contained 300 cc. by volume, or 830 grams by weight, of squid beaks and eye lenses as set forth. This does not include a large handful of eyes and beaks lost when the front end of the stomach was cut off. The number of beaks and the number of eye lenses, respectively, in various size-classes follow: Extremely large, 6 and 17; large, 155 and none; average (Ommastrephes?), 23 and 439; small (Watasenia?), 85 and 292; miscellaneous (partly broken, encrusted with mineral deposit, etc.), 65 and none. The totals were 336 beaks or 168 pairs, and 748 eye lenses or 374 pairs.

It is difficult to explain the discrepancy between the numbers of eye lenses and beaks unless a differential in digestibility is assumed.—A. J. NICHOLSON, *Fish and Wildlife Service, P. O. Box 1381, Billings, Montana. Received December 31, 1952.*

EXTRA PREMOLARS IN THE RIVER OTTER

On November 7, 1950, Mr. Thomas Dorsey shot a river otter (*Lutra canadensis*) at the Norwottuck Fish Hatchery in Amherst, Massachusetts. This specimen was presented to the Museum of Vertebrate Zoology, University of Massachusetts and is now a part of the collection, skin and skull No. 2321.

This animal according to the age determination of Hooper and Ostenson (Occas. Papers Mus. Zool. Univ. Michigan, 518: 9, 1949) is between age group 1, and age group 2. The skull is smooth, the dorsolateral ridges exist as lines only, the squamosal-jugal suture is only partially fused, the nasals are fused but the suture lines are distinct, the jugal-maxillary suture is visible and the lambdoidal ridges are only slightly marked. From the work of Hooper and Ostenson (*loc. cit.*) it would seem that the age of this animal is between 9 months and one year.

Upon examination of the dentition of this specimen it was found that the dental formula did not agree with the characteristic dental formula of the river otter as given by Anthony (FIELD BOOK OF NORTH AMERICAN MAMMALS, 1928). The presence of two additional premolars on the lower jaw increased the total number of teeth from 36 to 38. These premolars are P_1, one on either side of the lower jaw. To ascertain what changes had taken place regarding the other teeth with the addition of an extra premolar, a series of teeth and skull measurements was taken. These measurements included the length of lower tooth row, lower premolar length, length of P_2 and P_3, and the condylobasal length. Since the additional premolar measured 1.6 mm. it was thought that either the teeth following were foreshortened, or the length of the lower tooth row was increased. In order to clarify these assumptions 31 otter skulls of all ages were measured and used in a comparative study.

From Table 1, it can be seen that the lower premolar length is longest in specimen No. 2321. Lower premolar lengths were often found longer than 17 mm., but in these cases the animals were always of older age groups and had much longer condylobasal lengths. In specimen No. 2321 it appears that the premolar length has been increased with the additional premolar. However, this increased length does not seem to be sufficient to allow the presence of an additional premolar on the lower jaw. The additional space must then, come from either the reduction of individual tooth lengths, or increased tooth row length. Table 1 shows that in no specimen regardless of condylobasal length is P_2 shorter than in specimen No. 2321. On the contrary, P_2 is usually much longer than the corresponding tooth in No. 2321. This seems to indicate a foreshortening of P_2 in specimen No. 2321. P_3 in specimen No. 2321 does not seem to have been markedly reduced in length when compared with the same tooth in other specimens of comparable age. Table 1 shows that the lower tooth row length is rather directly related to the condylobasal length and does not seem to vary markedly with the addition of an extra premolar.

In seven of the specimens examined, additional unoccupied space was found on the lower

TABLE 1.—*Measurements of otter skulls of approximately 1 yr. ±. All Measurements in millimeters*

CONDYLOBASAL LENGTH	LOWER TOOTH ROW LENGTH	LOWER PREMOLAR LENGTH	P_1	P_2	P_3
No. 2321					
101.3	41.2	17	1.6	3.8	5.1
102.6	41.8	16.7		4.6	5.1
104.7	43.3	16.5		4.0	5.0
100.7	40.4	16		4.4	5.2
99.5	40	15.3		3.8	5.0
99.6	41.2	15.8		4.5	4.8
101.8	41.4	16.7		4.4	5.6

jaw. It seems feasible that in these specimens there was room for a supplementary premolar.

Discussion.—With an additional premolar in the lower jaw several changes occur. These changes seem to be primarily related to premolar length and the size of the individual premolars. P_2 is reduced to a greater extent than is P_3. The lower tooth row length does not seem to indicate any change and this suggests that the molars may also be slightly foreshortened although no measurements of the molars were taken to verify this assumption.

Acknowledgements.—My sincere thanks are extended to Dr. Wm. H. Burt, Museum of Zoology, University of Michigan, for his kind loan of otter skulls.—LYLE C. DEARDEN, *University of Massachusetts, Amherst.* *Received February 18, 1953.*

RACCOONS OF THE BAHAMA ISLANDS

The only raccoon mentioned from the Bahama Islands by Goldman (North Amer. Fauna, 60:75, 1950) is *Procyon maynardi* Bangs, which is recorded only from New Providence Island. It is therefore noteworthy that raccoons are abundant on Grand Bahama, and were apparently introduced from peninsular Florida.

Parts of skulls of raccoons were presented to the departmental collection (catalog numbers 880–883 inclusive) by Dr. J. A. Oliver. He and Mr. B. W. Cooper picked them up near West End Settlement, Grand Bahama, on June 5, 1949. They saw tracks of these animals and were told that raccoons have been on the island for years. These specimens include a nearly perfect lower jaw and a part of the skull composed of the premaxillary, maxillary and much of the frontal bones of the right side and with all teeth present except the median incisor. The teeth of the upper and lower jaw fit together so well as to suggest that they are from the same individual. These specimens are very similar in size and proportions to the corresponding parts of the skull of specimen No. 2462 of the author's collection of *Procyon lotor elucus* Bangs, which was taken near Leesburg, Florida.

Additional evidence of the occurrence of raccoons on Grand Bahama was furnished by Drs. Archie F. Carr and E. Lowe Pierce, who told me that these animals are abundant near West End Settlement. With their assistance, I was able to secure the skin and skull of a specimen from this locality. In coloration and skull characters this specimen, No. 2605 of the author's collection, is similar to specimens from peninsular Florida and is readily distinguished from specimens of *Procyon maynardi*.

I am indebted to the U. S. National Museum and Dr. Albert Schwartz for the loan of specimens of *Procyon maynardi* used for comparison. Incidentally, specimen No. 121905 of the U. S. National Museum is apparently the specimen of an adult male, whose skull measurements are given on page 75 of North American Fauna No. 60. Zygomatic width is given erroneously as 79.3 instead of 69.3 mm.

Upon inquiry, Senior Commissioner Herman Pyfrom, West End, Grand Bahama, wrote me May 20, 1952, that he is informed that Jack Morris turned loose a pair of raccoons and a pair of opossums in the vicinity of West End in the year 1932 or 1933, which were brought from the mainland of Florida. He states, "there is no trace of the possum. Apparently they did not survive but the raccoons have multiplied immensely and in consequence are a great nuisance to the peasant farmer as he is now unable to raise such crops as corn and peanuts. They are now scattered over the entire island even through the vast pine forest. . . ." A second letter from Mr. Pyfrom states that he is unable to learn of the raccoon having been introduced in Grand Bahama more than once. This leads to the interesting probability that the descendants of one pair of raccoons have become so numerous in 19 or 20 years as to seriously interfere with agriculture, and also that a pair of opossums transplanted at the same time were unsuccessful.—H. B. SHERMAN, *Department of Biology, University of Florida, Gainesville.* *Received November 3, 1952.*

WEIGHTS, MEASUREMENTS, AND COLOR OF THE CHILEAN FOREST PUMA

When the Chilean forest puma (*Felis concolor araucanus*) was described (Osgood, Field Mus. Nat. Hist., Zool. Ser., 30: 77, 1943) there were besides the immature male type, two

TABLE 1.—*Measurements, in millimeters, and weights of Chilean forest pumas*

	♂	♀	♀	♀	♀	♀	IMM. ♀	IMM. ♀	IMM. ♀	JUV.
Skin:										
Total length			1530	1565	1560	1560	1370	1430	1260	715
Tail			545	580	600	560	520	520	480	245
Hind foot			230	210.0	225	215	225	230	245	
Ear			87	83.0	78	80	82	85	76	
Weight			23.5k	22.7	23.8	24.5	14.7	16.6	9.6	
Skull:										
Greatest length	193.0	174.0	166.0	166.0	164.0	172.0	151.0	157.0	142.0	
Condylo-basal length	171.0	158.0	151.0	151.6	152.6	155.5				
Palatal length	77.6	72.5	67.6	69.4	67.7	70.0				
Interorbital width	39.7	37.3	35.1	31.6	32.5	33.7				
Postorbital width	52.3	52.1	41.1	41.3	43.6	42.3				
Zygomatic width	140.2	120.5	115.0	116.6	—	116.3				
Mastoid width	81.8	70.7	67.5	67.8	66.5	69.3				
Length of nasals	45.2	40.7	37.6	36.6	—	39.8				
Upper tooth row	67.7	55.9	53.6	55.5	53.9	55.9				
Length of upper carnassial	22.2	21.2	21.7	19.8	20.6	20.9				

skins with skulls and one skin only and one skull only. Recently Dr. Dillman S. Bullock, collector of the original series, has sent to Chicago Natural History Museum four adult females, three immatures, and one spotted juvenile.

Dr. Bullock took careful weights and measurements which are worthy of record. While none of these equal in size the female paratype measured by Dr. Osgood, they provide some figures on the size range for females of this race. It is a small animal compared with the large North American forms. The adult females are about five feet in length and weigh 50–54 pounds. The measurements of the male and female paratypes are also listed for comparison (Table 1).

Color.—These specimens are stuffed skins and have not been tanned so the colors should be closer to the natural ones. Two adults are in the red phase, a dark brown-red. In one the upper fourth and lower half of the ear is black, the remaining quarter being dark gray, and there is a black tip on the tail. In the other there is no black on the ears and but a tuft of black hairs on the end of the tail. These were taken on May 5 and June 3 respectively.

The other two adults are in the gray phase, with no black on the ears and only a few black hairs on the tip of the tail. One has a little more brown on the back than the other. They were taken on May 14 and October 13.

The three immature (about two years old) females are darker than the adults in the gray phase and are about the color of the type. In two, the ears are black and gray as in one of the red phase specimens, and in the other there is no black in the ears. The black in the tail varies from a tuft to an inch on the end of the tail. All of these were taken in October.

The juvenile specimen is a buffy brown above, lightening on the sides. There are two rows of black lines and spots down the back and three much lighter rows on each side. The backs of the ears are black with a gray center. The tail has six dark rings and a two inch black tip. The chin and throat are white followed by a band of buff on lower throat. The chest and lower belly are white with scattered black spots and the center of the belly is buff crossed by three or four dark bars. The animal was taken August 10 and is judged to be about three or four months old.—Colin Campbell Sanborn, *Chicago Natural History Museum, Chicago 5, Illinois.* *Received December 18, 1953.*

BASKING HABIT OF THE JAPANESE BEAR

The interesting basking habit of the Japanese black bear (*Ursus thibetanus japonicus* Schlegel) has been known for sometime among the hunters of Mt. Naeba (a peak of the central mountain range of Honshu). Recently, I obtained photographs of the so-called "basking couch" of the bear. I will note some facts concerning this queer habit, according to the information of Mr. Kihei Takahashi, who also obtained the pictures.

The photographs were taken on April 20, 1951, on a sunny slope at the height of about 1400 M. above sea-level, situated near the upper middle zone of the Naeba (138° 41′ E., 36° 50′ N., Height 2145 M.), where the wintering caves or holes are usually found between 1200 M. and 1600 M. The depth of snow was 120 cm. as compared with other places averaging 160 cm. at that time.

The basking couch is made from branches and twigs of those trees growing near about, mainly rhododendron (*Rhododendron Metternichii* Siebold et Zuccarini) and cedar (*Chamaecyparis pisifera* Endlicher). With those branches, which the bear must have broken off and carried by himself to the place (as was clearly seen by the scars from his claws and fangs) he made a comfortable cushion, elliptical in form (130 cm. x 100 cm.), its thickness being quite sufficient to support his body softly, when he lay down on it.

It is believed that bears usually lie on such cushions to dry their fur during a few days preceding their retirement to the wintering places. The size of the bear hunted in this district is 50–120 kg. in the male and 45–70 kg. in the female, which occasionally is accompanied by her suckling cub or yearling.—K. Hirasaka, *Department of Biology, Niigata University, Niigata City, Japan.*

A CASE OF CANNIBALISM IN CANADA LYNX (*LYNX CANADENSIS*)

On March 14, 1951 a partially eaten carcass of a lynx was found on the trap-line area of Mr. J. Russel, five miles east of Timmins in Northern Ontario.

Tracks in the snow indicated that a pair of young lynx were hunting snowshoe hare in a balsam fir-black spruce bush where the trees were about 10′–12′ in height. They were following a parallel course about 100 yards apart. As one of the young lynx approached the only tall black spruce in the area a large lynx made a rush at the smaller lynx, which leaped into the spruce. In three bounds the adult overtook the younger one, pulled it down from the tree and killed it.

The flesh was eaten from the hind legs and as far forward as the kidneys. The animal was not moved from the spot of the kill.—C. A. Elsey, *Fish and Wildlife Division, Department of Lands and Forests, Swastika, Ontario. Received January 16, 1953.*

THE ELEPHANT SEAL (*MIROUNGA ANGUSTIROSTRIS*) IN OREGON

The body of an adult male elephant seal, *Mirounga angustirostris* (Gill), was washed upon the beach four miles south of Bandon, Coos County, Oregon, during a storm in the last week of November, 1952. On December 5, 1952, when the authors collected the skull, the carcass was still in a fine state of preservation.

As far as can be ascertained this is the first record of this species from Oregon, although specimens have been reported from Washington (Seattle Times, April 15, 1947, p. 3), British Columbia (Cowan and Carl, Can. Field Nat. 59: 170–171, 1945) and Alaska (Willett, Jour. Mamm. 24: 500, 1943).

The skull, now in the Oregon State College Museum of Natural History, has the following measurements: basal length, 408 mm.; zygomatic width, 265; width of occipital condyles, 109; width of skull at posterior edge of the meatus auditory externus, 241; width of skull at the level of the upper posterior premaxillary suture, 141; length of nasal, 72; and combined width of nasals, 51.

The dentition shows extensive wear even on the broken surfaces of the right upper canine. The left upper molar apparently never erupted.

When the skull was collected the internal nasal regions were very tightly packed with fish bones, identifiable remains being the hake, *Merluccius productus*. Apparently this condition existed before death and possibly caused death, as the surrounding tissues were greatly congested with blood.—Richard E. Freiburg and Philip C. Dumas, *Oregon State College Museum of Natural History, Corvallis. Received January 21, 1953.*

RUTTING BEHAVIOR OF THE WHITETAIL DEER (*ODOCOILEUS VIRGINIANUS*)

Naturalists have long noticed the "pawed circles" that appear during the time of the rut in woods frequented by whitetail deer. It has been rightly assumed that they were made by bucks as a part of their rutting behavior, but apparently the act of making a circle has never been clearly seen and fully described. I would like to describe how one of these circles was made, as I observed it on the E. S. George Reserve of the University of Michigan, near Pinckney, Livingston County, Michigan. It took place at about 8:00 AM on November 14, 1952, weather clear, light southeast wind, air temperature 27°F, relative humidity 80 per cent, in second-growth oak-hickory woods at the edge of an abandoned grassy field. A salt block that was much used by deer was located at this corner of the field, about 20 feet from the site of the circle.

The buck, estimated to weigh about 225 pounds, and carrying a fine, wide-spreading eight point rack, came through the woods and paused just inside the edge. He rattled his antlers on low oak limbs and uttered several low grunts. He reached up and grasped low-hanging oak limbs in his mouth, pulled them down, and, by twisting his head, raked his antlers through them.

Alternating with this activity were spells when he pawed the ground with his forefeet,

throwing soil and leaves up over his back, and raked his antlers, first one side and then the other, through the leaves and loose soil.

Occasionally the buck would wheel in a circle, flash his flag, grunt, and then resume his antler-rattling and pawing. The whole procedure was strongly reminiscent of the actions of a domestic bull when he smells a cow in heat or is working himself into a frenzy preparatory to a charge.

After about ten minutes of this activity, the buck moved along at a slow walk inside the edge of the woods, head and neck outthrust, occasionally shaking his antlers and all the while uttering low, whining grunts. He moved like this for about 300 feet until he caught my scent and flushed. No other deer were seen or heard during the entire time of this whole procedure.

Inspection of the spot immediately after the buck had left revealed the presence of a typical "pawed circle" about three feet in diameter, where all the leaves had been removed and the soil torn and trampled, with hoof and antler marks plainly and deeply imprinted. Loose soil was scattered for several feet around the circle on top of the leaf litter. No evidence of fresh urine was noted. The lower limbs of the tree immediately over the circle were torn, scarred, and broken.—WILLIAM O. PRUITT, JR., *Museum of Zoology, University of Michigan, Ann Arbor.* *Received December 1, 1952.* (*Current address: Arctic Aeromedical Laboratory, Ladd AFB, Fairbanks, Alaska*)

ICTONYX KAUP, 1835, THE CORRECT GENERIC NAME, AND *ICTONYX STRIATUS* (PERRY), 1810, THE CORRECT SPECIFIC NAME FOR THE AFRICAN STINKMUISHOND

The type species of *Zorilla* I. Geoffroy, 1826, is, as Hershkovitz (Proc. Biol. Soc. Washington, 62: 14, 1949) points out, "Le Zorille, Buff. T. XIII, pl. 41; *Mustela Zorilla* et *Viverra Zorilla* des auteurs systématiques . . ."

Since the only bibliographical reference is to Buffon, the identity of *Zorilla* I. Geoffroy must clearly be that of Buffon's plate. Hershkovitz (*loc. cit.*) said that the earliest name based solely on Buffon's reference is *Viverra mapurita* Müller, 1776, and selected this as the type species. At the same time Hershkovitz, basing himself on the colour of the rim of the ears as shown in Buffon's plate, and attaching little weight to the other characters depicted and described by Buffon, and also apparently (Jour. Mamm., 34: 379, 1953) on the notoriously fallacious ground of the country of origin as given in the text, expressed the opinion that Le Zorille of Buffon was the Cape Stinkmuishond, currently known as *Ictonyx striatus* (Perry), 1810.

Ellerman & Morrison-Scott (Jour. Mamm., 34: 114, 1953) pointed out that Buffon's plate did not show an African mustelid, but a *Spilogale*. As a result of this Hershkovitz (1953, 379) has now decided to regard Le Zorille of Buffon as unidentifiable, and has selected instead *Mustela zorilla* E. Geoffroy, 1803, Cat. Mamm. Mus. Nat. Hist., 102, as the type species of *Zorilla* I. Geoffroy, 1826.

We cannot agree with this action. In the first place, we submit that authors should not cancel their selections of type species and substitute others, unless there has been some technical error in the original selection. But secondly, *Mustela zorilla* "E. Geoffroy, 1803" is unavailable since the Cat. Mamm. Mus. Nat. Hist. was never published. This is made quite clear by I. Geoffroy, 1839, Magazin de Zoologie (2) 1, page 5 of the text dealing with mammal plates 1–4, and the work was rejected by Sherborn. Setzer, 1952, Proc. U. S. Nat. Mus., 102: 343, thought that I. Geoffroy said that his father's work *had* been published. But it transpires (*in litt.*) that Setzer was relying on a faulty rendering of the French text.

Hershkovitz's selection of *Mustela zorilla* "E. Geoffroy, 1803" is therefore abortive, and we return to Le Zorille of Buffon as the type species of *Zorilla* I. Geoffroy, 1826, which cannot be applied to the African Stinkmuishond. Furthermore, since *M. zorilla* Lacépède, 1799 (1803), is based on Buffon's Zorille, and since *M. zorilla* Desmarest, 1818, is antedated by *Bradypus striatus* Perry, 1810, the name of the African Stinkmuishond remains where it was (*pace* Hershkovitz) as *Ictonyx striatus* (Perry).

The Commission laid down, in Paris in 1948, and reaffirmed, in Copenhagen in 1953, its views on how stability in nomenclature should be attained. We renew our protest against attempts to clear one's own nomenclatural waters by muddying those of others. We propose to ask the Commission to safeguard the established names *Ictonyx* Kaup, 1835, and *Ictonyx striatus* (Perry), 1810, by placing them on the respective *Official Lists*, and also to relegate the names *Zorilla*, *Mustela zorilla* and *Viverra zorilla*, now hopelessly confused, to the respective *Official Indices*. At the same time we propose to apply for *Spilogale* to be placed on the *Official List* in the sense in which it is currently used in America. We hope colleagues will support us in this action.—J. R. Ellerman and T. C. S. Morrison-Scott, *British Museum (Natural History), London, S.W. 7. Received October 6, 1953.*

[Note: As far as this editor is concerned, this will conclude the discussion of this topic in the pages of the Journal of Mammalogy]

RECENT LITERATURE

(Conducted by David H. Johnson, Claude W. Hibbard, Charles P. Lyman, Richard H. Manville, and Henry W. Setzer)

[Reprints of this section may be purchased from the Corresponding Secretary]

Altmann, Margaret. Social graces in elk society. Animal Kingdom, New York Zool. Soc., vol. 16, no. 3, pp. 66–72, illus. June, 1953.

Appelman, F. J. Vom Banteng (*Bibos sondaicus*). Zool. Garten, Leipzig, n.F., vol. 19, no. 5, pp. 189–192. 1952.

Arnold, Rudolf. Das Verbreitungsgebiet der Elefanten zu Beginn der historischen Zeit. Zeitschr. Säugetierk., Berlin, vol. 17, no. 2, pp. 73–82. February 19, 1953.

Ashton, E. H. An accessory cusp on the lower first permanent molar of the chimpanzee and gorilla. Proc. Zool. Soc. London, vol. 123, pt. 1, pp. 27–32, pl. 1. June 10, 1953.

Atkeson, Thomas Z., and David C. Hulse. Trapping versus night hunting for controlling raccoons and opossums within sanctuaries. Jour. Wildlife Management, Ithaca, vol. 17, no. 2, pp. 159–162. April, 1953.

Atkinson, Agnes Akin. Br'er Possum, hermit of the lowlands. Nat. Geogr. Mag., Washington, vol. 103, no. 3, pp. 405–418, illus. March, 1953.

Baker, Rollin H. Mammals from owl pellets taken in Coahuila, Mexico. Trans. Kansas Acad. Sci., Topeka, vol. 56, no. 2, pp. 253–254. 1953.

Baker, Rollin H. The pocket gophers (genus Thomomys) of Coahuila, Mexico. Univ. Kansas Publ., Mus. Nat. Hist., Lawrence, vol. 5, no. 28, pp. 499–514. June 1, 1953. (New: *Thomomys bottae humilis*, *T. b. villai*, *T. b. retractus*, *T. b. augustidens*.)

Banz, Konrad. Vom Baumschläfer (*Dryomys nitedula obolenskii* Ogn.) in Südrussland. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 153–155. February 19, 1953.

Barclay, O. R. Some aspects of the mechanics of mammalian locomotion. Jour. Exper. Biol., Cambridge, England, vol. 30, no. 1, pp. 116–120. March, 1953.

Barnett, C. H., and J. R. Napier. The rotatory mobility of the fibula in eutherian mammals. Jour. Anatomy, Cambridge, England, vol. 87, pt. 1, pp. 11–21. January, 1953.

Bassett, E. G., and C. P. McMeekan. Observations on the cattle pituitary. New Zealand Jour. Sci. & Technol., sec. A, vol. 32, no. 6, pp. 1–13. April, 1951.

Bazun, Irena. Zmiany morfohistologiczne grasicy u *Sorex araneus* L. w cyklu życiowym. (Morphohistologische Veränderungen des Thymus im Lebenszyklus von *Sorex araneus* L.) Ann. Univ. Mariae Curie-Sklodowska, Lublin, vol. 7, no. 5, pp. 253–304. September 1, 1952. (In Polish, with German summary.)

Becker, K. Über das Vorkommen schwarzer Wanderratten (*Rattus norvegicus* [Erxl.]). Zool. Garten, Leipzig, n.F., vol. 19, no. 5, pp. 223–233. 1952.

BERLEPSCH, HANS VON. Meine Hausratte. Zool. Garten, Leipzig, n.F., vol. 19, no. 5, pp. 220–222. 1952.

BOETTICHER, HANS V. Lassen sich die Gehörnformen von einander ableiten und ist dabei eine Entwicklungsrichtung zu erkennen? Zeitschr. Säugetierk., Berlin, vol. 18, no. 2, p. 136. September 28, 1952.

BOETTICHER, HANS VON. Der Begriff der "Untergattung" im zoologischen System. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 146–149. February 19, 1953.

BOETTICHER, HANS VON. Gedanken über eine natürliche systematische Gruppierung der Gazellen (*Gazellae*). Zeitschr. Säugetierk., Berlin, vol. 17, no. 2, pp. 83–92. February 19, 1953.

BOHMANN, LUDWIG. Die afrikanische Nagergattung *Otomys* F. Cuvier. Eine systematisch-zoogeographische Studie bei besonderer Berücksichtigung der Beziehungen zwischen Klimawechsel und Entwicklung. Zeitschr. Säugetierk., Berlin, vol. 18, no. 1, pp. 1–80. 1952.

BOROWSKI, STANISLAW, AND AUGUST DEHNEL. Materialy do biologii *Soricidae*. (Angaben zur Biologie der *Soricidae*.) Ann. Univ. Mariae Curie-Sklodowska, Lublin, vol. 7, no. 6, pp. 305–448. October 1, 1952. (In Polish, with German summary.)

BOUCHUD, J. La mandibule du renne. Mammalia, Paris, vol. 17, no. 1, pp. 27–49, illus. March, 1953.

BREATHNACH, A. A. The olfactory tubercle, prepyriform cortex and precommisural region of the porpoise (*Phocaena phocaena*). Jour. Anat., Cambridge, England, vol. 87, pt. 2, pp. 96–113. April, 1953.

BRIDGES, WILLIAM. Four little faces and four little temperaments. Animal Kingdom, New York Zool. Soc., vol. 16, no. 3, pp. 90–91, illus. June, 1953. (Chimpanzees.)

BROSSET, A. Remarques sur le comportment des chiroptères pendant la période de reproduction. Mammalia, Paris, vol. 17, no. 2, pp. 85–88. June, 1953.

BRUNNER, GEORG. Zur Osteologie der Spitzmäuse 2: *Neomys*, *Beremendia*, *Pachyura*. Zeitschr. Säugetierk., Berlin, vol. 17, no. 2, pp. 93–101, illus. February 19, 1953.

BRUST, JEAN. Some observations on the behavior of the golden hamster (*Cricetus auratus*). Naturalist, no. 845, pp. 61–65. April–June, 1953.

BULL, P. C. Parasites of the wild rabbit, *Oryctolagus cuniculus* (L.) in New Zealand. New Zealand Jour. Sci. & Techn., sec. B, vol. 34, no. 5, pp. 341–372. March, 1953.

BULL, P. C. Distribution of the nematode *Trichostrongylus retortaeformis* (Zeder, 1800) in the wild rabbit, *Oryctolagus cuniculus* (L.). New Zealand Jour. Sci. & Tech., sec. B, vol. 34, no. 6, pp. 449–456. May, 1953.

BUTLER, L. The nature of cycles in populations of Canadian mammals. Canadian Jour. Zool., Ottawa, vol. 31, no. 3, pp. 242–262. June, 1953.

CASWELL, EDWIN B. A mole from Idaho. Murrelet, Seattle, vol. 34, no. 1, p. 9. 1953.

CAUBÈRE, B. Miniopterus schreibersi (Natterer) dans le Loir-et-Cher. Mammalia, Paris, vol. 16, no. 4, pp. 257–258. December, 1952.

CHASE, H. B., W. MONTAGNA, AND J. D. MALONE. Changes in the skin in relation to the hair growth cycle. Anat. Record, Philadelphia, vol. 116, no. 1, pp. 75–82. May, 1953.

CHATELAIN, EDWARD F. Winter range problems of moose in the Susitna Valley. Science in Alaska, Proc. Second Alaskan Science Conf., 1951, pp. 343–347. 1953.

CLARKE, IRA D., AND FRANK G. ASHBROOK. A test of raccoon skins for suede leather. Jour. Amer. Leather Chemists Assoc., vol. 48, no. 5, pp. 294–299. May, 1953.

COCKRUM, E. LENDELL. Aberrations in the color of the prairie vole, Microtus ochrogaster. Trans. Kansas Acad. Sci., Topeka, vol. 56, no. 1, pp. 86–88, illus. 1953.

COFFIN, A. LYNN, AND JACK D. REMINGTON. Pregnant yearling cow elk. Jour. Wildlife Management, Ithaca, vol. 17, no. 2, p. 223. April, 1953.

COLBERT, EDWIN HARRIS, AND DIRK ALBERT HOOIJER. Pleistocene mammals from the limestone fissures of Szechwan, China. Bull. Amer. Mus. Nat. Hist., New York, vol. 102, art. 1, pp. 1–134, illus. June 12, 1953. (New: *Charronia flavigula tyrannus*,

Viverra zibetha expectata, Moschus moschiferus plicodon, Bibos gaurus grangeri, Capricornis sumatraensis kanjereus.)

COLLS, D. G. Surveys of elk and other wildlife in Riding Mountain National Park, Manitoba, 1950–1951, and 1952. Wildlife Management Bull., Canadian Wildlife Service, Ottawa, ser. 1, no. 6, pp. 25, illus. December, 1952.

COTT, HUGH B. The palatability of the eggs of birds: illustrated by experiments on the food preferences of the ferret (*Putorius furo*) and cat (*Felix catus*); with notes on other egg-eating Carnivora. Proc. Zool. Soc. London, vol. 123, pt. 1, pp. 123–141. June 10, 1953.

CRANE, HAROLD S., AND DALE A. JONES. Initial proof of mule deer fawns breeding is found in Utah. Jour. Wildlife Management, Ithaca, vol. 17, no. 2, p. 225. April, 1953.

DAVIS, DAVID E. A perspective on rat control. Public Health Repts., Washington, vol. 67, no. 9, pp. 888–893. September, 1952.

DAVIS, DAVID E., ROBERT Z. BROWN, AND WILLIAM B. JACKSON. The effect on mouse populations of sprinkling industrial effluent in an oak woods. Trans. Sixteenth North Amer. Wildlife Conf., pp. 283–289, illus. 1951.

DECHAMBRE, ED. Les callosités individuelles peuvent-elles devenir héréditaires? Mammalia, Paris, vol. 17, no. 2, pp. 89–95. June, 1953.

DIDIER, ROBERT. Note sur les os péniens de quelques pinnipèdes de la Terre Adélie. Mammalia, Paris, vol. 17, no. 1, pp. 21–26, illus. March, 1953.

DIDIER, ROBERT. Etude systématique de l'os pénien des mammifères. Rongeurs. [Part]. Mammalia, Paris, vol. 17, no. 2, pp. 67–74, illus. June, 1953. (*Heliosciurus, Funambulus, Glaucomys, Marmota, Castor.*)

DOBSON, JESSIE. John Hunter and the early knowledge of the anthropoid apes. Proc. Zool. Soc. London, vol. 123, pt. 1, pp. 1–12, pls. 1–4. June 10, 1953.

DORAN, DAVID J. Coccidiosis in the kangaroo rats of California. Univ. California Publ. Zool., vol. 59, no. 2, pp. 31–60, illus. April 22, 1953.

DORST, Jean. Note sur la dentition d'un foetus de Lavia frons (chiroptères, mégadermatidès). Mammalia, Paris, vol. 17, no. 2, pp. 83–84. June, 1953.

DRAKE, HAROLD, AND ERNEST S. BOOTH. Revision of the ranges of the pocket gophers of southeastern Washington and northeastern Oregon and the description of a new subspecies Thomomys talpoides whitmani. Walla Walla College Publ., Dept. Biol. Sci. & Biol. Sta., vol. 1, no. 3, pp. 44–58, illus. November 25, 1952. (New: *Thomomys talpoides whitmani.*)

DUNTON, SAM. A new world for Mambo. Animal Kingdom, New York Zool. Soc., vol. 56, no. 2, pp. 48–50, illus. April, 1953. (Lowland gorilla.)

DZIERZYKRAJ-ROGALSKA, IRENA. Zmiany histomorfologiczne tarczycy *S. a. araneus* L. w cyklu życiowym. (Histomorphologische Veränderungen der Schilddrüse in Lebenszyklus *S. a. araneus* L.). Ann. Univ. Mariae Curie-Sklodowska, Lublin, vol. 7, no. 4, pp. 213–252. August 15, 1952. (In Polish, with German summary.)

ÉHIK, GY. The occurrence of the root-vole (Microtus oeconomus Pall.) at the Kisbalaton. Ann. Hist.-Nat. Mus. Nat. Hungarici, Budapest, ser. nov., vol. 3, pp. 251–256, pl. 13. 1953.

EICHLER, WOLFDIETRICH. Ein Haarling mit eigenartiger wirtlicher und geographischer Verbreitung. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, p. 171. February 19, 1953.

EICHLER, WD., AND JOH. HERTEL. Hamster im Hausgarten. Zool. Garten, Leipzig, n.F., vol. 18, nos. 3–4, pp. 153–154. 1951.

ELKINS, W. A. Needed research on Alaskan fur animals. Science in Alaska, Proc. Second Alaskan Science Conf., 1951, pp. 355–362. 1953.

ESTANOVE, J. La loutre et sa disparition. Mammalia, Paris, vol. 16, no. 4, pp. 256–257. December, 1952.

FÉLIX, A. Notes sur la faune de Birao. Mammalia, Paris, vol. 17, no. 2, pp. 54–66, illus. June, 1953.

FERNÁNDEZ BALLAS, W., AND C. OBERTI S. Histogénesis y significado de la fibra muscular estriada en mamíferos. Biológica, Trab. Inst. Biol. "Juan Noe" Univ. Chile, Santiago, fasc. 14–15, pp. 15–27, illus. 1952.

FOKANOV, V. A. Obzor fauny mlekopitayushchix Priuralnovo raiona Zapadno-Kazakhstanskoi oblasti. Trudy Zool. Inst. Akad. Nauk SSSR, Moscow, vol. 11, pp. 204–213. 1952.

FRANK, FRITZ. Die feldmammologische Unterscheidung von Feldmaus und Erdmaus (Microtus arvalis und Microtus agrestis). Bonner Zool. Beiträge, Heft 1–2, pp. 13–16. 1953.

GAZIN, C. LEWIS. The Tillodontia: An early Tertiary order of mammals. Smithsonian Misc. Coll. Washington, vol. 121, no. 10, pp. 1–110, illus. June 23, 1953. (New: *Trogosus grangeri, T. hillsii, Tillodon.*)

GOETHE, FRIEDRICH. Beiträge zur Säugetierfauna von Südost-Karelien. Zeitschr. Säugetierk., Berlin, vol. 17, no. 2, pp. 102–114, pl. 11. February 19, 1953.

GOETZ, JÓZEF. Rozmieszczenie krolika dzikiego (*Oryct. cuniculus* L.) w Poln.-Wschodniej Polsce. (Distribution of *Oryctolagus cuniculus* L. in north-east Poland.) Polska Akad. Umiejetnosci, Cracow, no. 29, pp. 1–12. March 19, 1952. (In Polish.)

GOODWIN, GEORGE G. A new pocket gopher of the genus *Heterogeomys* from Tamaulipas. Amer. Mus. Novitates, New York, no. 1620, pp. 3. May 4, 1953. (New: *Heterogeomys hispidus negatus.*)

GRIFFIN, D. R. Physiological thermodynamics of Arctic animals. Science in Alaska, Proc. Second Alaskan Science Conf., 1951, pp. 93–97. 1953.

GROTE, HERMANN. Übersicht über die Säugetierfauna des Pamirgebiets. Zool. Garten, Leipzig, n.F., vol. 18, nos. 3–4, pp. 142–145. 1951.

GRZIMEK, BERNHARD. Affenfreihaltung im Zoo. Zool. Garten, Leipzig, n.F., vol. 18, nos. 3–4, pp. 138–140. 1951.

GUIMARÃES, DJALMA. Arqui-Brasil e sua evolucao geologica. Bull. Minist. Agric. Republica Brasil, no. 88, pp. 314, illus. 1951. (Lists Cenozoic mammals.)

HAKALA, JOHN B. Productivity and growth rates of beaver in interior Alaska. Science in Alaska, Proc. Second Alaskan Science Conf., 1951, pp. 327–330. 1953.

HALL, OCTAVIA. Accessory corporea lutea in the wild Norway rat. Texas Repts. Biol. & Med., vol. 10, no. 1, pp. 32–38. Spring, 1952.

HARRISON, J. L. Introducing bats. Malayan Nature Jour., vol. 7, no. 2, pp. 56–63. June, 1952.

HART, J. S. Use of daily metabolic periodicities as a measure of the energy expended by voluntary activity of mice. Canadian Jour. Zool., Ottawa, vol. 30, no. 1, pp. 49–54. February, 1952.

HART, J. S. Effect of temperature and work on metabolism, body temperature and insulation: results with mice. Canadian Jour. Zool., Ottawa, vol. 30, no. 1, pp. 83–89. February, 1952.

HART, J. SANFORD. The relation between thermal history and cold resistance in certain species of rodents. Canadian Jour. Zool., Ottawa, vol. 31, no. 2, pp. 80–98. April, 1953.

HART, J. SANFORD. Energy metabolism of the white-footed mouse, *Peromyscus leucopus noveboracensis*, after acclimation at various environmental temperatures. Canadian Jour. Zool., Ottawa, vol. 31, no. 2, pp. 99–105. April, 1953.

HART, J. SANFORD. Rate of gain and loss of cold resistance in mice. Canadian Jour. Zool., Ottawa, vol. 31, no. 2, pp. 112–116. April, 1953.

HART, J. SANFORD. The influence of thermal acclimation on limitation of running activity by cold in deer mice. Canadian Jour. Zool., Ottawa, vol. 31, no. 2, pp. 117–120. April, 1953.

HAYMAN, R. W. A new Uranomys from Nyasaland. Ann. Mag. Nat. Hist., ser. 12, vol. 6, no. 64, pp. 317–318. April, 1953. (New: *Uranomys ruddi shortridgei.*)

HEPTNER, W. G. Zur Nomenclatur der Waldmäuse. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 160–161. February 19, 1953.

HIBBARD, CLAUDE W. The Saw Rock Canyon fauna and its stratigraphic significance. Papers Michigan Acad. Sci., Arts & Letters, vol. 38 (1952), pp. 387–411, illus. April 27, 1953. (New: *Onychomys larrabeei; Baiomys sawrockensis; Cimarronomys, C. stirtoni.*)

HIESTAND, W. A., F. W. STEMLER, AND J. E. WIEBERS. Gasping patterns of the isolated respiratory centers of birds and mammals during anoxia, their phylogenetic significance and implication in hibernation. Physiol. Zoology, Chicago, vol. 26, no. 2, pp. 167–172. April, 1953.

HILL, W. C. OSMAN. Primates: comparative anatomy and taxonomy. Vol. 1, Strepsirhini. Stechert-Hafner, New York, pp. 798, illus. 1953.

HILL, W. C. OSMAN. Note on the taxonomy of the genus *Tarsius*. Proc. Zool. Soc. London, vol. 123, pt. 1, pp. 13–16. June 10, 1953.

HILL, W. C. OSMAN. Caudal cutaneous specializations in *Tarsius*. Proc. Zool. Soc. London, vol. 123, pt. 1, pp. 17–26, pls. 1–3. June 10, 1953.

HILL, W. C. OSMAN. Early records of the slender loris and its allies. Proc. Zool. Soc. London, vol. 123, pt. 1, pp. 43–47. June 10, 1953.

HILZHEIMER, MAX. Eine Hornscheide und ein Hirnschädel eines Wisents aus dem Alluvium Pommerns. Zeitschr. Säugetierk., Berlin, vol. 17, no. 2, pp. 141–145. February 19, 1953.

HOCK, RAYMOND J. Rectal temperatures of the black bear during its "hibernation". Science in Alaska, Proc. Second Alaskan Science Conf., 1951, pp. 310–312. 1953.

HORNUNG, VIKTOR. Zur Naturgeschichte des Igels, *Erinaceus europaeus*. Zool. Garten, Leipzig, n.F., vol. 18, nos. 3–4, p. 152. 1951.

HORNUNG, VIKTOR. Eichhörnchen nascht Birkensaft. Zool. Garten, Leipzig, n.F., vol. 19, no. 5, pp. 258–259. 1952.

HURME, V. O., AND G. VAN WEGENEN. Basic data on the emergence of deciduous teeth in the monkey (Macaca mulatta). Proc. Amer. Philos. Soc., Philadelphia, vol. 97, no. 3, pp. 291–315, illus. June 30, 1953.

IRVING, LAURENCE. Studies on physiological adaptation to cold in Arctic mammals. Science in Alaska, Proc. Second Alaskan Science Conf., 1951, pp. 113–117. 1953.

JACOB, E. Metodische Krankheits-Bekämpfung und-Verhütung bei Zootieren. Zool. Garten, Leipzig, n.F., vol. 19, no. 5, pp. 243–248. 1952.

JACZEWSKI, ZBIGNIEW. Effect of unilateral castration on antlers growth in roe-deer (*Capreolus capreolus* L.) and common stag (*Cervus elaphus* L.). Fragmenta Faunistica Mus. Zool. Polonici, Warsaw, vol. 6, no. 12, pp. 199–205, pl. 1, July 26, 1952.

JOHNSON, H. M. Preliminary ecological studies of microclimates inhabited by the smaller arctic and subarctic mammals. Science in Alaska, Proc. Second Alaskan Science Conf., 1951, pp. 125–131. 1953.

JOHNSON, MURRAY L., AND PHILLIP W. CHENEY. Synaptomys in Idaho and northeastern Washington. Murrelet, Seattle, vol. 34, no. 1, p. 10. 1953.

JONES, F. WOOD. Some readaptations of the mammalian pes in response to arboreal habits. Proc. Zool. Soc. London, vol. 123, pt. 1, pp. 33–41. June 10, 1953.

JONES, J. KNOX, JR., AND RICHARD B. LOOMIS. Additional records of the spotted ground squirrel and black-footed ferret in Kansas. Trans. Kansas Acad. Sci., Topeka, vol. 56, no. 1, p. 107. 1953.

JONES, ROBERT D., JR. A report of sea otter investigations conducted during 1951. Science in Alaska, Proc. Second Alaskan Science Conf., 1951, pp. 351–355. 1953.

JONSGÅRD, ÅGE. Whales in aquarium. Norsk-Hvalfangst-Tidende (Norwegian Whaling Gazette), Sandefjord, vol. 42, no. 6, pp. 309–321. June, 1953.

KANAGASUNTHERAM, K. Observations on the anatomy of the hoolock gibbon. Ceylon Jour. Sci., sec. G, vol. 5, pt. 1, pp. 11–64, illus. September, 1952.

KATTINGER, E. Bemerkungen über Tigerpferde. Zeitschr. Säugetierk., Berlin, vol. 17, no. 2, pp. 115–122, pls. 12–15. February 19, 1953.

KAWAKAMI, TAKEHIKO, KEN OTSURO, SETSUO WATASE, AND KEN-ICHI IGUCHI. The Bonin Islands areas. Report on Whale Marking in Japan, Japanese Fisheries Agency, Tokyo, no. 4, pp. 1–10, figs. 1–4. April, 1953.

KITTAMS, WALTER H. Reproduction of Yellowstone elk. Jour. Wildlife Management, Ithaca, vol. 17, no. 2, pp. 177–184. April, 1953.

KOSTRITSKY B., LEÓN, AND ALVARY PIAZZA L. El cachalote, su caza y aprovechamiento en el Peru. Pesca y Caza, Minist. Agric., Lima, Peru, no. 5, pp. 31–52, illus. 1952.

KOWALSKI, KAZIMIERZ. Rytmika dobowa aktywności gryzoni *Clethrionomys glareolus glareolus* Schreber i *Sylvimus flavicollis flavicollis* Melchior i jej zależność od warunków świetlnych. (The daily rhythm of activity of the rodents *Clethrionomys glareolus glareolus* Schreber and *Sylvimys flavicollis flavicollis* Melchior, and its dependence on lighting conditions.) Rozprawy Wydziału Matematyczno-Przyrodniczego, Polska Akad. Umiejętności, Krakow, vol. 74, sect. B (ser. 3, vol. 34), no. 4, pp. 12–37. 1950. (In Polish; reprint accompanied by summary in English.)

KOWALSKI, KAZIMIERZ. Badania nad ekologią drobnych ssaków, leśnych w okolicy Krakowa. (Investigations on the ecology of forest small mammals in the neighbourhood of Krakow.) Materialy do Fizjografii Kraju, Polska Akad. Umiejętności, Krakow, no. 22, pp. 18, illus. 1950. (In Polish, with English summary.)

KOWALSKI, KAZIMIERZ. Brekcja nietoperzowa w Podlesicach kolo Kroczyc w Pow. Olkuskim. (La brèche à ossements de chauves-souris.) Zabytki Przyrody Nieożywionej (Monuments de la Nature Inanimée), Warsaw, n.s., no. 1 (4), pp. 38–40. 1951.

KOWALSKI, K., AND R. J. WOJTUSIAK. Homing experiments on bats. Part I. Bull. Acad. Polonaise Sci. & Lettres, Krakow, Classe Sci. Math. & Nat., ser. B, Sci. Nat. (II), 1951, pp. 33–56, pls. 3–4. 1952.

KRAGLIEVICH, JORGE LUCAS, AND SANTIAGO RIVAS. Orophodon Amegh. representante de una nueva superfamilia Orophodontoidea del suborden Xenarthra. Com. Mus. Argentino Cien. Nat., vol. 2, no. 2, pp. 9–28, illus. September, 1951. (New: Superfamily *Orophodontoidea*.)

KRAGLIEVICH, JORGE LUCAS. Contribuciones al conocimiento de los primates fosiles de la Patagonia. Com. Mus. Argentino Cien. Nat., vol. 2, no. 5, pp. 55–82, illus. September, 1951. (New: *Dolichocebus*, *D. gaimanensis*.)

KRAGLIEVICH, JORGE LUCAS. Un canido del Eocuartario de Mar del Plata y sus relaciones con otras formas brasileñas y norteamericanas. Rev. Mus. Municipal Ciencias Nat. y Tradic. Mar del Plata, vol. 1, entrega 1, pp. 53–70, illus. December, 1952. (New: *Protocyon scagliarum*.)

KRUMBIEGEL, INGO. Giraffenmischlinge. Zool. Garten, Leipzig, n.F., vol. 18, nos. 3–4, pp. 109–114. 1951.

KRUMBIEGEL, INGO. Das "Waitoreki", ein angeblich neues Säugetier von Neuseeland. Zeitschr. Säugetierk, Berlin, vol. 18, no. 2, pp. 110–115. September 28, 1952.

KUBIK, JERZY. *Micromys minutus* Pall. w Bialowieskim Parku Narodowym. (Zwergmaus-*Micromys minutus* Pall. im Naturschutzpark von Bialowieza.) Ann. Univ. Mariae Curie-Sklodowska, Lublin, vol. 7, no. 7, pp. 449–495. October 15, 1952. (In Polish, with German summary.)

KÜHLHORN, FRIEDRICH. Ein hornloser Yak. Zool. Garten, Leipzig, n.F., vol. 18, nos. 3–4, p. 150. 1951.

KÜHLHORN, FRIEDRICH. Beobachtungen über die Biologie von *Hesperomys musculinus* Thomas. Zeitschr. Säugetierk., Berlin, vol. 18, no. 2, pp. 116–124. September 28, 1952.

KURODA, NAGAMICHI. Mammalogical history of Formosa with zoogeography and bibliography. Quart. Jour. Taiwan Mus., Taipei, vol. 5, no. 4, pp. 267–304. December, 1952.

LAURIE, ELEANOR M. O. Rodents from British Honduras, Mexico, Trinidad, Haiti and Jamaica collected by Mr. I. T. Sanderson. Ann. Mag. Nat. Hist., ser. 12, vol. 6,

no. 65, pp. 382–394. May, 1953. (New: *Ototylomys brevirostris, O. b. affinis, Nyctomys sumichrasti colimensis.*)

LAWRENCE, BARBARA, AND ARTHUR LOVERIDGE. Zoological results of a fifth expedition to East Africa. I. Mammals from Nyasaland and Tete. With notes on the genus *Otomys*. Bull. Mus. Comp. Zool., Cambridge, vol. 110, no. 1, pp. 1–80, pls. 1–3. June, 1953. (New: *Steatomys pratensis nyasae, Dasymys incomtus alleni, Otomys uzungwensis, O. barbouri.*)

LEHMANN, ERNST VON. Vergleichende Beobachtungen an den häufigsten Kleinsäugern des Hohen Venns. Bonner Zool. Beiträge, Heft 1–2, pp. 17–20. 1953.

LENNEP, E. W. VAN, AND W. L. VAN UTRECHT. Preliminary report on the study of the mammary glands of whales. Norsk Hvalfangst-Tidende (Norwegian Whaling Gazette), Sandefjord, vol. 5, no. 42, pp. 249–258. May, 1953.

LINSDALE, JEAN M., AND P. QUENTIN TOMICH. A herd of mule deer. A record of observations made on the Hastings Natural History Reservation. Univ. California Press, pp. xiii + 567, illus. 1953.

LOCHTE, TH. Untersuchungen an Haaren eines neugeborenen Nilpferdes und eines Zwergflusspferdes. Zool. Garten, Leipzig, n.F., vol. 18, nos. 3–4, pp. 119–124. 1951.

LOCHTE, TH. Das mikroskopische Bild des Giraffenhaares. Zool. Garten, Leipzig, n.F., vol. 19, no. 5, pp. 204–206. 1952.

LYMAN, C. P., AND E. H. LEDUC. Changes in blood sugar and tissue glycogen in the hamster during arousal from hibernation. Jour. Cellular & Comp. Physiol., Philadelphia, vol. 41, no. 3, pp. 471–492. June, 1953.

MACKENZIE, J. M. D. A note on some natural barriers in Burma. Jour. Bombay Nat. Hist. Soc., vol. 51, no. 1, pp. 189–199, map. December, 1952.

MANN F., GUILLERMO. Filogena y función de la musculatura de *Marmosa elegans* (Marsupialia, Didelphydae). Investig. Zool. Chilenas, Santiago, vol. 1, fasc. 9, pp. 1–15, illus. March, 1953.

MANNER, ALFRED. Kleine Beobachtungen an der Bisamratte, *Fiber zibethicus* L. Zool. Garten, Leipzig, n.F., vol. 18, nos. 3–4, pp. 146–148. 1951.

MARSHALL, J. T., JR. Suggestions as to collecting land vertebrates on coral atolls. Atoll Research Bull., Pacific Science Board, Washington, no. 17, pp. 65–68. May 15, 1953.

MARTIN, F. R., AND L. W. KREFTING. The Necedah Refuge deer irruption. Jour. Wildlife Management, Ithaca, vol. 17, no. 2, pp. 166–176, illus. April, 1953. (Central Wisconsin.)

MCCLUNG, ROBERT M. Deer: those adaptable animals. Animal Kingdom, New York Zool. Soc., vol. 56, no. 2, pp. 34–44, illus. April, 1953.

MCGREW, PAUL O. A new and primitive early Oligocene horse from Trans-Pecos Texas. Fieldana-Geology, Chicago Nat. Hist. Mus., vol. 10, no. 15, pp. 167–171, fig. 1. June 19, 1953. (New: *Haplohippus, H. texanus.*)

MCLAUGHLIN, CHARLES A., AND WILLIAM B. ROBERTSON. A new record of the rice rat, *Oryzomys palustris palustris*, from southern Illinois. Nat. Hist. Misc., Chicago Acad. Sci., no. 80, pp. 2. March 30, 1951.

MCMILLAN, JOHN F. Measures of association between moose and elk on feeding grounds. Jour. Wildlife Management, Ithaca, vol. 17, no. 2, pp. 162–166. April, 1953.

MELARGNO, H. P., AND W. MONTAGNA. The tactile hair follicles in the mouse. Anat. Record, Philadelphia, vol. 115, no. 2, pp. 129–150. February, 1953.

MIYAZAKI, ICHIRO, KEN OTSURO, AND SETSUO WATASE. The Sanriku-Hokkaido and South Kurile Islands areas. Report on Whale Marking in Japan, Japanese Fisheries Agency, Tokyo, no. 4, pp. 10–18, figs. 5–10. April, 1953.

MIYAZAKI, ICHIRO. Results of capture of marked whales. Report on Whale Marking in Japan, Japanese Fisheries Agency, Tokyo, no. 4, pp. 18–20. April, 1953.

MOCHI, UGO, AND T. DONALD CARTER. Hoofed mammals of the world. Scribner's, New York, pp. 14 (not numbered) + 40 pls. with text, bibliography. 1953.

MORRISON-SCOTT, T. C. S., AND A. H. BISHOP. The coat colour of the grey squirrel (*Sciurus*

carolinensis) with other notes. Proc. Zool. Soc. London, vol. 121, pt. 4, pp. 773-775, pls. 1-3. February 8, 1952.

MORRISON-SCOTT, T. C. S. The mummified cats of ancient Egypt. Proc. Zool. Soc. London, vol. 121, pt. 4, pp. 861-867. February 8, 1952.

NESENI, RAIMUND. Winterruhe oder Winterschlaf des Waschbären. Ein Beitrag zum Stoffwechsel des Waschbären zur Winterszeit. Zeitschr. Säugetierk., Berlin, vol. 18, no. 2, pp. 81-109. September 28, 1952.

NIETHAMMER, G. Über das Schicksal des Peloponnes-Rehes. Zeitschr. Säugetierk., Berlin, vol. 17, no. 2, pp. 123-126. February 19, 1953.

OMURA, HIDEO, KEIJIRO MAEDA, AND ICHIRO MIYAZAKI. Whaling in the adjacent waters of Japan. Norsk Hvalfangst-Tidende (Norwegian Whaling Gazette), Sandefjord, vol. 42, no. 4, pp. 199-212, illus. April, 1953.

PATTERSON, BRYAN. Un nuevo y extraordinario marsupial deseadino. Rev. Mus. Municipal Ciencias Nat. y Tradic. Mar del Plata, vol. 1, ent. 1, pp. 39-44, illus. December, 1952. (New: Family Groeberiidae, *Groeberia, G. minoprioi.*)

PATTERSON, BRYAN. Notas acerca del craneo de un ejemplar juvenil de Mesotherium cristatum Serr. Rev. Mus. Municipal Ciencias Nat. y Tradic. Mar del Plata, vol. 1, ent. 1, pp. 71-78, illus. December, 1952.

PETERSON, RANDOLPH L. Studies of the food habits and the habitat of moose in Ontario. Contrib. Royal Ontario Mus. Zool. & Palaeontol., Toronto, no. 36, pp. 49, illus. May 30, 1953.

PETZSCH, HANS. Zwei ungewöhnliche Fälle von Brutpflege beim europäischen Hamster (*Cricetus cricetus* L.). Zool. Garten, Leipzig, n.F., vol. 19, no. 5, pp. 259-260. 1952.

POHLE, HERMANN. Die Wildsäuger von Kreta. 3) Über Fledertiere von Kreta. Zeitschr. Säugetierk., Berlin, vol. 17, no. 1, pp. 14-20. February 19, 1953.

POHLE, HERMANN. Über die Fledertiere von Bougainville. Zeitschr. Säugetierk., Berlin, vol. 17, no. 2, pp. 127-137. February 19, 1953.

PRESNALL, CLIFFORD C. Coyotes can't win against rodents. Nat. Wool Grower, vol. 43, no. 6, pp. 22-23. June, 1953.

RACEY, KENNETH. Cottontail rabbit in British Columbia. Murrelet, Seattle, vol. 34, no. 1, pp. 9-10. 1953.

RAFFERTY, M. G., AND C. G. HARTMAN. Early death of ovum in the opposum with observations on moribund mouse eggs. Jour. Morphol., Philadelphia, vol. 92, no. 3, pp. 455-486. May, 1953.

REIG, OSVALDO A. Observaciones sobre *Notictis ortizi* Amegh. Ann. Soc. Cienc. Argentina, vol. 104, pp. 3-9, illus. July, 1952.

REIG, OSVALDO A. Sobre la presencia de mustélidos mefitinos en la formacion de Chapadmalal. Rev. Mus. Municipal Ciencias Nat. y Tradic. Mar del Plata, vol. 1, ent. 1, ent. 1, pp. 45-51, illus. December, 1952. (New: *Conepatus altiramus.*)

REIG, OSVALDO A. Nuevos datos descriptivos sobre *Chapalmatherium novum* Amegh. Rev. Mus. Municipal Ciencias Nat. y Tradic. Mar del Plata, vol. 1, ent. 1, pp 105-117, illus. December, 1952.

REIG, OSVALDO A. Descripción previa de nuevos ungulados y marsupiales fosiles del Plioceno y del Eocuartario argentinos. Rev. Mus. Municipal Ciencias Nat. y Tradic. Mar del Plata, vol. 1, ent. 1, pp. 119-129, illus. December, 1952. (New: *Platygonus scagliae, P. marplatensis, Paradidelphis pattersoni, P. brachyodonta, Thylophoros, Thylatheridium, T. cristatum.*)

REINHART, ROY. Diagnosis of the new mammalian order, Desmostylia. Jour. Geol., Chicago, vol. 61, no. 2, p. 187. March, 1953.

REYNOLDS, H. C. The opossum. Scientific American, New York, vol. 188, no. 6, pp. 88-95. June, 1953.

REYNOLDS, THOMAS E., KARL F. KOOPMAN, AND ERNEST E. WILLIAMS. A cave faunule from western Puerto Rico with a discussion of the genus Isolobodon. Breviora, Mus. Comp. Zool., Cambridge, no. 12, pp. 1-8, illus. April 23, 1953.

RHODE, CLARENCE J., AND WILL BARKER. Alaska's fish and wildlife. Circular U. S. Fish & Wildlife Service, no. 17, pp. 60, illus. 1953.

RICHARDS, STEPHEN H., AND RUTH L. HINE. Wisconsin fox populations. Tech. Wildlife Bull., Game Management Div., Wisconsin Conserv. Dept., Madison, no. 6, pp. 1–78. 1953.

SAILER, OTTO. Bericht über "Kälber-Diphtherie" beim Elefanten. Zool. Garten, Leipzig, n.F., vol. 18, nos. 3–4, pp. 103–105. 1951.

SAINT GIRONS, M. C. Note sur le territoire et le cycle d'activité d'*Atlantoxerus getulus* L. dans le Massif du Toubkal (Haut Atlas marocain). Mammalia, Paris, vol. 17, no. 2, pp. 75–82, illus. June, 1953.

SAKIURA, HARUYUKI, KATSUNARI OZAKI, AND KAZUO FUJINO. Biological investigation of the northern Pacific baleen whales caught by the Japanese whaling fleet in 1952. Fisheries Agency Japanese Govt., Tokyo, pp. 64. May, 1953.

SAKIURA, HARUYUKI, YASUTAKE NOZAWA, AND KATSUNARI OZAKI. Study on maturity and blubber thickness of the whales caught in the adjacent waters of Japan. Fisheries Agency Japanese Govt., Tokyo, pp. 25. May, 1953.

SANDIDGE, LEWIS L. Food and dens of the opossum (Didelphis virginiana) in northeastern Kansas. Trans. Kansas Acad. Sci. Topeka, vol. 56, no. 1, pp. 97–106. 1953.

SAPIN-JALOUSTRE, J. Les phoques de Terre Adélie (suite et fin). Mammalia, Paris, vol. 17, no. 1, pp. 1–20, pls. 3. March, 1953.

SCHARLEMANN, E. Über eine neue Unterart des Perlziesels, *Citellus suslica volhynensis* subsp. nov. Zeitschr. Säugetierk., Berlin, vol. 17, no. 2, pp. 138–140. February 19, 1953.

SCHLOTT, M. Erfahrungen bei der Giraffenzucht. Zool. Garten, Leipzig, n.F., vol. 19, no. 5, pp. 171–180. 1952.

SCHLOTT, M. Zur Verbreitung von *Microtus ratticeps* in Schlesien. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 169–170. February 19, 1953.

SCHMID, ELISABETH. Ein abnormes Foramen einer Pferdephalange. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 173–175. February 19, 1953.

SCHREITMÜLLER, WILHELM. Einiges über die Wasserspitzmaus (*Neomys fodiens* Pall.). Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 149–151. February 19, 1953.

SCHREITMÜLLER, WILHELM. Pipistrellus pipistrellus Bechst. und *Nyctalus noctula* Schreb. fressen Glüwürmchen. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 151–152. February 19, 1953.

SCHREITMÜLLER, WILHELM. Melanistische und albinotische Eichhörnchen (*Sciurus vulgaris* L.). Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 152–153. February 19, 1953.

SCHREITMÜLLER, WILHELM. Der Baumschläfer (*Dryomys nitedula* Pall.) in Gefangenschaft. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 155–157. February 19, 1953.

SCHREITMÜLLER, WILHELM. Die Brandmaus (*Apodemus agrarius* Pall.) im Käfig. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 161–163. February 19, 1953.

SCHREITMÜLLER, WILHELM. Die Kurzohrmaus (*Pitymys subterraneus* DeSelys) in Gefangenschaft. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 166–169. February 19, 1953.

SCHREITMÜLLER, WILHELM. Eine Schermaus überfällt eine Ringelnatter. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 170–171. February 19, 1953.

SCHREITMÜLLER, WILHELM. Einiges über zahme Fischottern (*Lutra lutra* L.). Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 172–173. February 19, 1953.

SCHREITMÜLLER, WILHELM. Die schwarze Wegschnecke (*Arion empiricorum* Fér.) als Säugernahrung. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 175–176. February 19, 1953.

SCHULZE, WILHELM. Darminvagination bei einem Bergkänguruh. Zool. Garten, Leipzig, n.F., vol. 19, no. 5, p. 257. 1952.

SCOTT, ROBERT F. Distribution and abundance of Dall sheep in Alaska. Science in Alaska, Proc. Second Alaskan Science Conf., 1951, pp. 340–343. 1953.

SEITZ, ALFRED. Eisbärenzucht im Nürnberger Tiergarten. Zool. Garten, Leipzig, n.F., vol. 19, no. 5, pp. 180–189. 1952.

SIEWERT, HORST. Die Wildsäuger von Kreta. 5) Der Siebenschläfer Kretas. Zeitschr. Säugetierk., Berlin, vol. 17, no. 1, pp. 52–57, pl. 8. February 19, 1953.

SIMM, K. Zębielek karliczek (*Crocidura mimula* Miller) w Polsce. (*Crocidura mimula* Miller (*Soricidae*) in Poland.) Polska Akad. Umiejetnosci, Cracow, no. 31, pp. 1–11. March 19, 1952. (In Polish, with English summary.).

SIMM, K. Crocidura mimula mimula G. S. Miller (1901) in Poland. Bull. Soc. Sci. & Lettres Poznan, ser. B, vol. 12, pp. 189–195. 1953.

SMITH, JUSTIN G., AND ODELL JULANDER. Deer and sheep competition in Utah. Jour. Wildlife Management, Ithaca, vol. 17, no. 2, pp. 101–112, illus. April, 1953.

SPIEGEL, ARNOLD. Weitere Beobachtungen über den zeitlichen Ablauf der Bezahnung u. des Zahnwechsels bei Javamakaken. Zeitschr. Säugetierk., Berlin, vol. 18, no. 2, pp. 125–135. September 28, 1952.

STRECKER, ROBERT L., AND JOHN T. EMLEN, JR. Regulatory mechanisms in house-mouse populations: the effect of limited food supply on a confined population. Ecology, Lancaster, vol. 34, no. 2, pp. 375–385, illus. April, 1953.

STROGANOV, A. S. Fauna mlekopitayushchix oroshaemyx zemel i lesnyx nasazhdenii Valuiskoi opytno-meliorativnoi stantsii. (Stalingradskaya obl.). Trudy Zool. Inst. Akad. Nauk SSSR, Moscow, vol. 11, pp. 214–234. 1952.

STULLKEN, DONALD E., AND CHARLES M. KIRKPATRICK. A determination of hole sizes which exclude certain predatory mammals. Jour. Wildlife Management, Ithaca, vol. 17, no. 2, pp. 124–128. April, 1953.

SUMNER, LOWELL, AND JOSEPH S. DIXON. Birds and mammals of the Sierra Nevada, with records from Sequoia and Kings Canyon National Parks. Univ. California Press, Berkeley, pp. xvii + 484, illus. 1953.

SVIHLA, ARTHUR. Relation of water to dormancy in aestivating and hibernating mammals. Science in Alaska, Proc. Second Alaskan Science Conf., 1951, p. 124. 1953.

THENIUS, ERICH. *Postpotamochoerus* nov. subgen. *hyotherioides* aus dem Unterpliozän von Samos (Griechenland) und die Herkunft der Potamochoeren. Sitz.-Ber. Österr. Akad. Wiss., Vienna, math.-naturw. Kl., vol. 159, pp. 25–36. 1950. (New: *Postpotamochoerus*, *Potamochoerus* (*Postpotamochoerus*) *hyotherioides*.)

THENIUS, ERICH. Die tertiären Lagomeryciden und Cerviden der Steiermark. Sitz.-Ber. Österr. Akad. Wiss., Vienna, math.-naturw. Kl., vol. 159, pp. 219–254, illus. 1950. (New: *Micromeryx styriacus*.)

THENIUS, ERICH. Ergebnisse paläontologischer Unterschungen an den Boviden (Mammal.) des Wiener Beckens. Neues Jahrb. Geol. & Paläontol., Monatshefte, Stuttgart, 1951, no. 9, pp. 273–282. September, 1951.

THENIUS, ERICH. Anthracotherium aus dem Untermiozän der Steiermark. Sitz.-Ber. Österr. Akad. Wiss., Vienna, math.-naturw. Kl., vol. 160, pp. 217–226. 1951.

THENIUS, ERICH. Eine neue Rekonstruktion des Höhlenbaren (*Ursus spelaeus* Ros.). Sitz.-Ber. Österr. Akad. Wiss., Vienna, math.-naturw. Kl., vol. 160, pp. 321–333, pls. 3. 1951.

THENIUS, ERICH. Die Säugetierreste aus dem Jungtertiär des Hausruck und Kobernausserwalden (O.-Österr.) und die Altersstellung der Fundschichten. Jahrb. Geol. Bundesanst., Vienna, vol. 95, pt. 1, pp. 119–144, illus. 1952.

THENIUS, ERICH. Zur Analyse des Gebisses des Eisbären, *Ursus* (*Thalarctos*) *maritimus* Phipps, 1774. Säugetierk. Mitteil., Stuttgart, vol. 1, no. 1, pp. 14–20, illus. January 10, 1953.

THOMPSON, DANIEL Q. Summer food preference of the brown and collared lemmings. Science in Alaska, Proc. Second Alaskan Science Conf., 1951, p. 347. 1953.

TINBERGEN, N. Social behavior in animals, with special reference to vertebrates. John Wiley & Sons, New York, pp. 150. 1953.

Transehe, N. v. Kamele und Rentiere in der Sowjetunion. Zool. Garten, Leipzig, n.F., vol. 18, nos. 3–4, pp. 150–151. 1951.

Van Den Brink, F. H. La musaraigne masquée, espèce circum-boréale. Mammalia, Paris, vol. 17, no. 2, pp. 96–125, 1 map. June, 1953.

Vereshchagin, N. K., and I. M. Gromov. K istorii fauny pozvonochnyx raiona nizhnevo techeniya reki Ural. Trudy Zool. Inst. Akad. Nauk SSSR, Moscow, vol. 9, pp. 1226–1269. 1952.

Villa R., Bernardo. Mamíferos silvestres del Valle de Mexico. Anales Inst. Biol., Mexico, vol. 23, nos. 1–2, pp. 269–492. 1952.

Vinogradov, B. S. Mlekopitayushchie krasnovodskovo raiona zapadnoi Turkmenii. Trudy Zool. Inst. Akad. Nauk SSSR, Moscow, vol. 10, pp. 7–44, 1952. (Fauna of Turkoman.)

Vinogradov, B. S. Kratkii obzor fauny mlekopitayushchix doliny nizhnevo techeniya r. Urala i prilezhashchix raionov. Trudy Zool. Inst. Akad. Nauk SSSR, Moscow, vol. 11, pp. 190–203. 1952.

Vinogradov, B. S., and I. M. Gromov. Gryzuny fauny SSSR. Opryedyeliteli po Faunye SSSR, Zool. Inst. Akad. Nauk SSSR, Moscow, no. 48, pp. 1–296. 1952. (Rodent fauna of the USSR)

Wagner, Helmuth O. Zur Populationsdynamik der Kleinnager in den Tropen und ihre Ursachen. Bonner Zool. Beiträge, Heft 1–2, pp. 1–12. 1953.

Wasilewski, Wacław. Badania nad morfologia *Clethrionomys glareolus glareolus* Schreb. Ann. Univ. Mariae Curie-Sklodowska, Lublin, vol. 7, no. 3, pp. 119–211. July 1, 1952. (In Polish, with German summary.)

Watson, D. M. S. The evolution of the mammalian ear. Evolution, Lancaster, vol. 7, no. 2, pp. 159–177, illus. June, 1953.

Watson, J. S., and C. H. Tyndale-Biscoe. The apophyseal line as an age indicator for the wild rabbit, Oryctolagus cuniculus (L.). New Zealand Jour. Sci. & Tech., sec. B, vol. 34, no. 6, pp. 427–435. May, 1953.

Wettstein, Otto v. Die Wildsäuger von Kreta. 2) Die Insectivora von Kreta. Zeitschr. Säugetierk., Berlin, vol. 17, no. 1, pp. 4–13, pls. 2. February 19, 1953.

Wilson, Kenneth A. Raccoon predation on muskrats near Currituck, North Carolina. Jour. Wildlife Management, Ithaca, vol. 17, no. 2, pp. 113–119, illus. April, 1953.

Wolska, Janina. Rozwój aparatu plciowego w cyklu życiowym *Sorex araneus* L. (I). (Die Entwicklung des Geschlects-apparates von *Sorex araneus* L. (I). Ann. Univ. Mariae Curie-Sklodowska, Lublin, vol. 7, no. 8, pp. 497–539. October 20, 1952. (In Polish, with German summary.)

Yamada, Munesato. [Discovery of Uki-Kujira, Kogia.] Shizen, vol. 7, no. 9, p. 65. 1952. (In Japanese.)

Yamada, Munesato. [Whaling at Taiji.] Shizen, vol. 7, no. 3, pp. 64–70, illus. 1952. (In Japanese.)

Yamada, Munesato. Contribution to the anatomy of the organ of hearing of whales. Sci. Repts. Whales Research Inst., Tokyo, no. 8, pp. 1–78, illus. 1953.

Yamaguchi, K., and K. Fujino. On the serological constitution of the striped dolphin, *Prodelphinus caeruleo-albus* (Meyen). Proc. Japan Acad., vol. 29, no. 2, pp. 61–67. February, 1953.

Yeager, Lee E. "Bone board" for big-game field workers. Jour. Wildlife Management, Ithaca, vol. 17, no. 2, pp. 223–225, illus. April, 1953.

Zimmermann, Klaus. Die Wildsäuger von Kreta. 1.) Einleitung. Zeitschr. Säugetierk., Berlin, vol. 17, no. 1, pp. 1–3, pl. 1. February 19, 1953.

Zimmermann, Klaus. Die Wildsäuger von Kreta. 4) Die Rodentia Kretas. Zeitschr. Säugetierk., Berlin, vol. 17, no. 1, pp. 21–51, pls. 3–4. February 19, 1953.

Zimmermann, Klaus. Die Wildsäuger von Kreta. 6) Die Carnivora von Kreta. Zeitschr. Säugetierk., Berlin, vol. 17, no. 1, pp. 58–65, pl. 9. February 19, 1953.

Zimmermann, Klaus. Die Wildsäuger von Kreta. 7) Bemerkungen über die Wildziege

Kretas. Zeitschr. Säugetierk., Berlin, vol. 17, no. 1, p. 66, pl. 10. February 19, 1953.

ZIMMERMANN, KLAUS. Die Wildsäuger von Kreta. 8) Das Gesamtbild der Säuger-Fauna Kretas. Zeitschr. Säugetierk., Berlin, vol. 17, no. 1, pp. 67–72. February 19, 1953.

ZIMMERMANN, KLAUS. Zur Biologie des Zwerghamsters (*Cricetulus migratorius* Pall.). Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 159–160. February 19, 1953.

ZIMMERMANN, KLAUS. Die Hausmaus von Helgoland *Mus musculus helgolandicus* sspec. nov. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 163–166. February 19, 1953. (New: *Mus musculus helgolandicus.*)

ZWEREW, M. D. Zur Biologie des Wüstenschläfers. Zeitschr. Säugetierk., Berlin, vol. 17, no. 3, pp. 158–159. February 19, 1953. (*Selevinia*)

COMMENTS AND NEWS

HONORARIA FOR GRADUATE STUDENTS

In order to encourage young mammalogists and to stimulate research, The American Society of Mammalogists awards Honoraria of fifty dollars ($50.00) each to young graduate students for the purpose of attending, and presenting a paper at, the annual meeting. Four such grants may be awarded each year for papers to be presented at the annual meeting.

Papers submitted for such awards for 1954 must be in the hands of the Committee on Honoraria for Graduate Students by April 1, 1954. Send manuscripts to the chairman of the committee, W. Robert Eadie, Fernow Hall, Cornell University, Ithaca, New York. For further details concerning the awards consult Journal of Mammalogy, Vol. 32, page 387.

The annual meeting in 1954 is definitely scheduled for June 14–17 near Rocky Mountain National Park in Colorado.

ANNUAL MEETING

The thirty-fourth annual meeting of the American Society of Mammalogists will be held at the town of Estes Park, Colorado, at the border of Rocky Mountain National Park, June 14–17, 1954. The directors will meet the evening of June 13. Details will be sent to members later by the Corresponding Secretary.

Such non-metropolitan meetings have been outstandingly successful in past years, and members are urged to make plans now for attending, and presenting a paper at, this meeting.

CHECK LIST OF NORTH AMERICAN AMPHIBIANS AND REPTILES

Many mammalogists will be interested to know that A CHECK LIST OF NORTH AMERICAN AMPHIBIANS AND REPTILES (Sixth Edition) by Karl P. Schmidt, 1953, is now ready for distribution. This work, sponsored by the American Society of Ichthyologists and Herpetologists, may be obtained for $3.50 per copy (280 pp., cloth), postpaid, by writing to N. Bayard Green, Publications Secretary, Department of Zoology, Marshall College, Huntington, West Virginia.

UNIFORMITY OF COMMON NAMES OF MAMMALS

I note with interest and initial approval the suggestion of Donald F. Hoffmeister (Jour. Mamm. 34: 285, 1953) that some measure of uniformity in the common names applied to North American mammals would be desirable, but I view with mild alarm his proposal that the list on pages xvii to xxi of Burt's FIELD GUIDE TO THE MAMMALS be adopted "in total" and "without change" as a standard. This is not a reflection upon that author's qualifications to propose such a standard, but rather arises from internal evidence that he did not

intend that it should so serve or at least that he did not concentrate the amount of serious effort and attention required for the compilation of a standard.

Perhaps an analysis of a few examples which come within my ability to discuss will indicate what I consider to be effective barriers to the adoption of this list *in toto*, and will suggest considerations which might well be in the minds of those who ultimately may produce a standard list of common names for North American mammals.

The FIELD GUIDE TO THE MAMMALS is properly concerned with opening up to the amateur and advanced amateur the complex of the American mammals, and is concerned with those characters by which the beginner can recognize mammals in the field. That the author was not primarily concerned with precision in common names is suggested by his use of the term "tassel-eared squirrels" for the creatures which have been known for many years and by many authors as tuft-eared squirrels.

Any formal attempt to fix or standardize common names should be approached with a recognition that such action is not a light matter, since one would be paralleling an established Latin nomenclature. Many of the features of the established Latin nomenclature would have to be reproduced in the standard common names, such as a different name for every species or other category assumed. Other features of standardized common names would be governed by different considerations than are the scientific names. In the latter the matter or priority is important, perhaps the ruling consideration, but it becomes of no significance in a common name.

The matter of appropriateness and descriptive accuracy should be uppermost in mind when proposing names for the use of laymen and amateurs for whom the scientific names are deemed inappropriate. In this connection such names as "ring-tailed cat" and "civet cat" for *Bassariscus* are misleading in that they suggest to the amateur things which a professional knows are not so, but which the amateur does not. If the layman knew enough not to be misled by such names, he would know enough to be able to use the established scientific nomenclature. In any case it would be necessary to decide once and for all whether "civet cat" should be applied to *Bassariscus* or to *Spilogale*, with the disquieting thought in the back of one's mind that the first European to attempt such a standardization of common names for the Old World fauna would be embarrassed by the misappropriation of what once was his exclusive property.

If, on the other hand, it is argued that such terms as "civet cat" and "antelope" are fixed by common usage and cannot be changed, one has ventured onto boggy grounds for taking liberties with *any* author's usages. The logical extension of this line might be the application of the rule of priority to common names, with the result that common names would become just as iron-clad and misleading as many scientific names, and the amateur, for whose benefit the new nomenclature was brought into being would be as much mystified by these as by the scientific names he finds so baffling.

With respect to fox squirrels, for example, it would appear that two common names do scant justice, from the layman's point of view, to the considerable and obvious differences in appearance in *Guerlinguetus*. "Eastern fox squirrel" as a name for *Sciurus niger rufiventer* and at the same time for *S. n. niger* seems at once a misleading extension of the term "eastern" as well as a misleading indication to the layman that the animals look alike. Presumably the modifier "eastern" is proposed to stand in apposition to "Apache" which it does not do with the utmost clarity. In addition, *Sciurus arizonensis* is not included, which serves as a suggestion that the list may omit other species in genera with which I am less familiar.

A blanket rule of insistence upon only one common name for each species is in effect a restriction of common names to scientific names, and requires careful consideration of its usefulness to the amateur, for if he is not furnished separate names for the things he can readily distinguish, he will invent them. He might, in eastern Colorado, come up with the term "western northern eastern fox squirrel" and be so overcome by its ineptness as to call the animal the "western fox squirrel", and we should thereby have gone full circle.

A list of standardized names arbitrarily assigned by any one person, or even a small group of persons, is almost certain to be just as arbitrarily rejected in whole or in part by those whose special interest, special knowledge, or regional peculiarities have been offended. The proper procedure would seem to be the publication, perhaps through several revisions, of a proposed list, inviting criticisms, suggestions, and alternative proposals.—HUGO G. RODECK, *University of Colorado Museum, Boulder, Colorado.*

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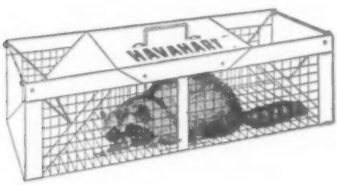

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